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Kuala Lumpur.

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THE
Malayan Agricultural Journal
OCTOBER, 1951.

EDITORIAL

Blister Blight of Tea. In this issue of the Journal the Acting Senior Plant Pathologist, Mr. A. Johnston, describes two trials he conducted at Cameron Highlands in connection with the spraying of tea bushes with fungicides to control the disease Blister Blight.

Although control had been obtained with one copper fungicide spray it was desirable to test others under local conditions and to this end an experiment was conducted using five different copper sprays, a sulphur spray and a copper dust. In his article, Mr. Johnston describes the experiment and gives the results obtained.

Present costs of labour and materials make spraying an expensive business, and a second experiment, described in the article, was carried out to ascertain the best volume and strength of spray to use.

Mechanical Cultivation of Padi. There are two articles on later pages describing the the mechanical cultivation experiments carried out on wet and dry padi land in Kelantan during the 1950-1951 padi season. The experiments are a continuation of those commenced in the 1948-1949 season and described in the July, 1949, issue of this Journal. The experiments conducted in the 1949-1950 season are described in a bulletin which is to be issued in the near future. Unfortunately publication of this bulletin has been delayed due to printing difficulties.

In the articles in this issue of the Journal, Mr. Berwick, who was Acting State Agricultural Officer, Kelantan, during most of the time when the experiments were made, describes the experiments and shows that, in the case of dry padi, yields can be increased by using tractors and ploughing deeply and also by using artificial manures. Few significant results were obtained in the experiments conducted on wet padi land but it is thought that, provided ploughing is not too deep, tractor ploughing is as good or better than cattle ploughing, especially when manures are used.

Improvement of Padi Varieties in Malaya. The article which appeared in the July, 1951, issue of the Journal followed instructions by the High Commissioner in Council that the work of Messrs. Jagoe and Larter should be published. The work of these two officers was the basis for an Information Paper to the Federal Executive Council.

BLISTER BLIGHT OF TEA IN MALAYA.

2. Results of Two Spraying Experiments

BY

ANTHONY JOHNSTON,

Acting Senior Plant Pathologist.

When blister blight of tea, caused by *Exobasidium vexans* Massee, first appeared in Malaya in February, 1950, spraying with copper fungicides was immediately commenced. As in other countries, good control was obtained (1). At the Agricultural Station, Tanah Rata, where the trials described below were carried out, routine spraying has been done with knapsack sprayers, using Perenox at a strength of 0.25 per cent. (4 ozs. in 10 gallons of water). Latterly, pressure-retaining knapsack sprayers have been mainly used, the volume of spray applied with these varying from 10 to 20 gallons per acre, with an average of about 13 gallons. Perenox has been used as the standard fungicide because it has been readily available locally and experience in Ceylon (2) and South India (3) has shown it to be effective in controlling the disease. It was desirable, however, to obtain information on the efficacy under local conditions of some other fungicides and to this end the first experiment described below was laid down. In addition, information was sought concerning the best volume and strength of spray to use; the second experiment was designed to provide some data on these points. As the most important aspect of spraying against blister blight is the protection of young growth during the period of recovery after pruning, these experiments were carried out on pruned bushes.

Experiment Details.

Both experiments were carried out between February and June, 1951. Bushes were pruned between the 16th and 20th February and treatments began three weeks later and continued at weekly intervals until the 8th June, by which time the bushes were ready for tipping. The total number of treatments was 14 in the first test and 13 in the second.

Weather during the period was not very favourable to blister blight attack, mornings usually being dry and sunny although afternoons tended to be dull. Spraying and dusting, which were done in the morning, never had to be carried out during rain, although on six occasions in both experiments rain fell soon after the treatments had been completed. Rainfall during the period is shown in Table I.

Table I.

Rainfall During the Experiments.

	16th to 28th February.	March.	April.	May.	1st to 8th June.
Rainfall (ins.)	6.42	3.40	10.75	6.78	1.06
Wet Days	8	16	20	26	7

Despite the fairly dry weather experienced during most of the period, moderately heavy infection occurred on the unsprayed bushes (Plate 1), especially towards the end of the experiments.

Spraying was done with a Vermorel "Fog" sprayer, using a variable nozzle set to give a fine mist spray. This gave a type of spray similar to that obtained with knapsack outfits. The volume of spray applied was regulated by using a set length of stroke of the piston, this length being controlled by attaching one end of a cord to the piston handle, the other end being attached to the front of the barrel of the sprayer (Plate 3). By adjusting the length of the cord, the required amount of fluid could be accurately emitted. The dust was applied with a small hand duster.

The experiments were of a simple randomised block design. The plots consisted of pruned bushes (five in each plot in the first experiment, four in the second) separated by single rows of unpruned bushes to guard against spray drift and prevent interaction between the treatments in adjacent plots. Infection was assessed by counting the blisters on the leaves of a random sample of shoots from each bush, stem infections being counted as occurring on the next leaf above. Ten shoots from each bush were examined in the first test and five in the second.

Test of Different Fungicides.

Five copper sprays, one sulphur spray and one copper dust were tested in this experiment. A preponderance of copper fungicides was used because these have been found most effective against blister blight in other countries (2, 3). The copper sprays tested included the proprietary compounds Blitox[1], Koneprox[2], Shell Copper Fungicide[3] (all copper oxychlorides) and Perenox[4] (cuprous oxide). These were all used at a strength of 0.25 per cent. Bordeaux mixture 2:2:40 was also used. These strengths gave in all cases a copper content of 0.125 per cent. Spersul[4] (at 0.5 per cent. dilution) was used as the sulphur spray while the copper dust used was Perelan[4]. The latter was applied at a rather low rate equivalent to just under 2 lbs. per acre, which made the amount of copper applied double that in the sprays. The sprays were applied at a rate of 20 mls. per plant and increased to 30 mls. per plant when the amount of foliage on the bushes became greater. These rates were equivalent to amounts of 12 and 18 gallons per acre respectively.

RESULTS.

The experiment contained six replications of eight treatments (including a no spray treatment). Treatment means are shown in Table II.

Spraying with all the copper fungicides, Perenox, Koneprox, Bordeaux Mixture, Shell Copper Fungicide and Blitox, gave significantly better control than spraying with Spersul or dusting with Perelan. The two latter treatments were in turn significantly better than no treatment. No significant difference was demonstrated between any of the copper spray treatments, nor between treatments with Spersul and Perelan.

[1] Pest Control Ltd. [2] Supplied by Malayan Fertilisers Ltd. [3] The Shell Co. of the Federation of Malaya Ltd. [4] Imperial Chemical Industries (Malaya) Ltd.

Table II.

Test of Different Fungicides.

Treatment Means.

Treatment.	Treatment Mean. (Blisters per Leaf)	Total Stem Blisters.
Perenox	0.225	1
Koneprox	0.238	0
Bordeaux Mixture	0.327	1
Shell Copper Fungicide	0.426	1
Blitox	0.435	1
Spersul	1.362	28
Perelan	1.446	17
No Spray	2.589	98

Minimum Significant Difference between Treatment Means (5 per cent.) = 0.511.

A further indication of the superiority of copper sprays over other treatments is provided by the figures for the total number of stem blisters occurring in each treatment (Table II). The copper sprays gave almost complete control over this aspect of the disease.

DISCUSSION.

From the practical point of view the control obtained with the five copper sprays was satisfactory (Plate 2), very few blisters being formed and little damage being done compared with that occurring on the unsprayed bushes (Plate 1). Adequate control was not obtained with Spersul or Perelan. In the latter case, better results might be achieved by using a more dilute dust at a higher rate as this would give better coverage.

Test of Different Strengths and Volumes of Spray.

In this experiment the fungicide used was Perenox. It was applied at four concentrations and four volumes. The concentration normally used in routine spraying on the Agricultural Station is 0.25 per cent., i.e. 4 ozs. in 10 gallons of water. The concentrations compared in this experiment were 0.5 per cent., 0.25 per cent., 0.125 per cent. and 0.0625 per cent., i.e. at twice normal, normal, half normal and quarter normal strength. The volume of spray usually applied varies between 10 and 20 gallons per acre; the volumes used in this test were equivalent to 5, 10, 20 and 40 gallons per acre, obtained by applying to each bush amounts of 8.3 mls. for the 5 gallons, 16.6 mls. for the 10 gallons, 33.2 mls. for the 20 gallons and 66.4 mls. for the 40 gallons treatment.

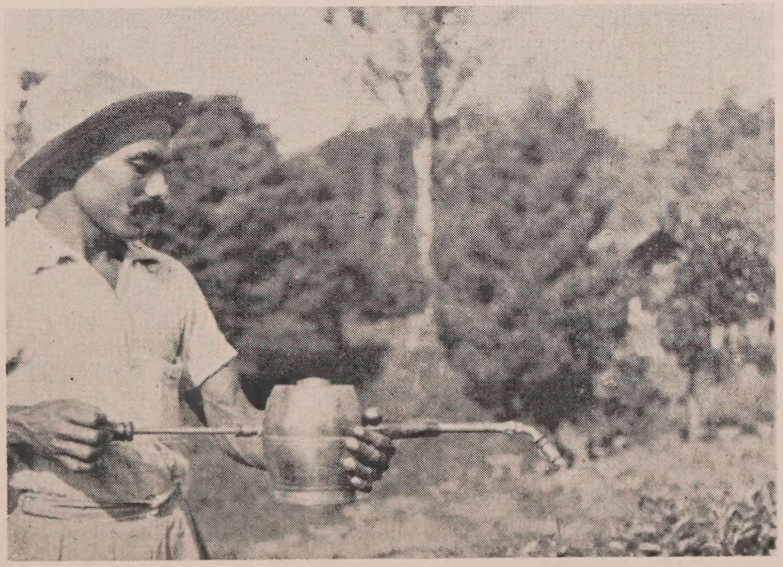
PLATE I.

Part of unsprayed bush.

PLATE II.

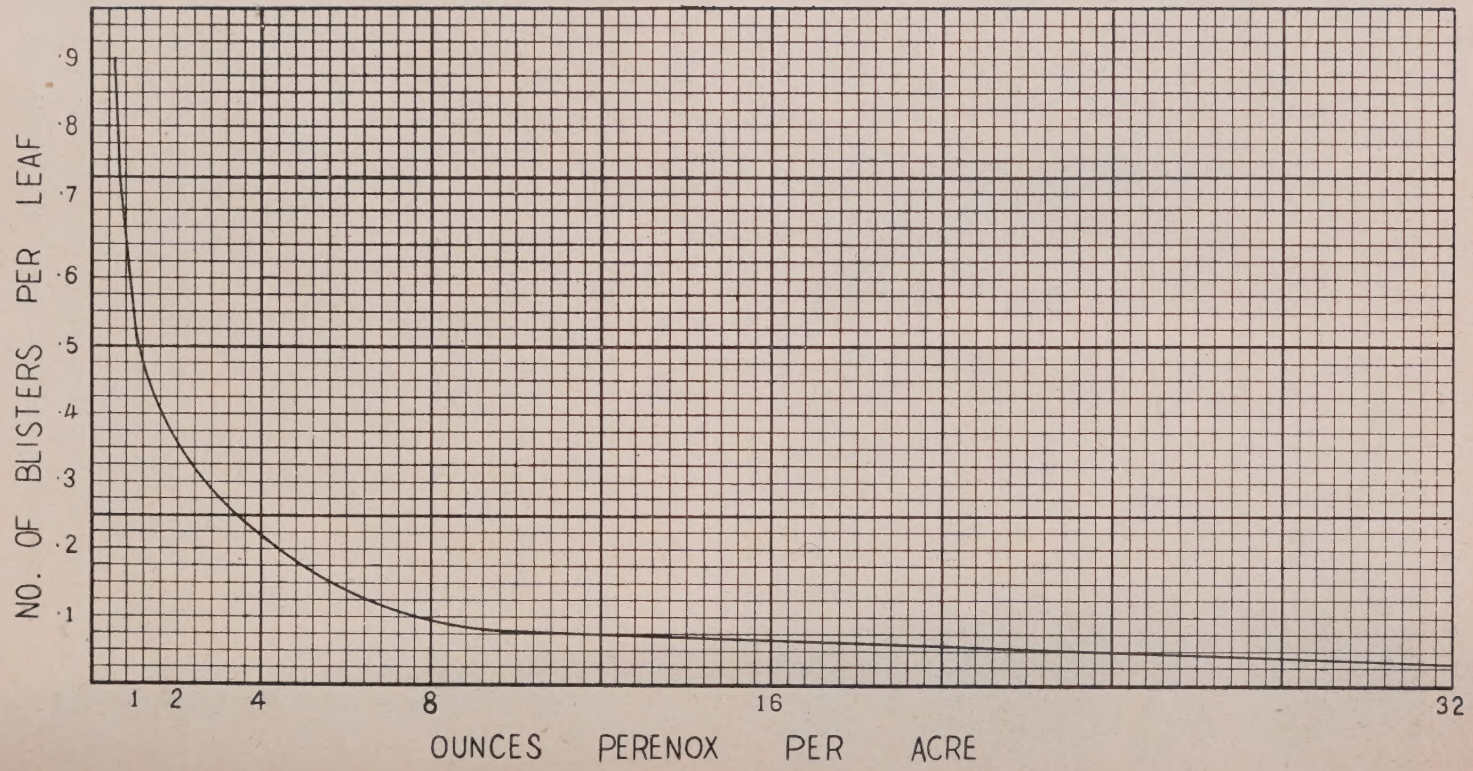
Part of bush sprayed with copper fungicide (Perenox).

PLATE III.



Sprayer used in experiments, showing regulating cord.

GRAPH I


NO. OF BLISTERS PER LEAF
·9
·8
·7
·6
·5
·4
·3
·2
·1
1
2
4
8
16
32
OUNCES PERENOX PER ACRE

All combinations of these variables were used, giving a total of 16 treatments (Table III). In this experiment, the sprayer was adjusted to give 8.3 mls. of spray at each stroke.

RESULTS.

Table III.
Test of Different Strengths and Volumes of Spray.
Treatment Means.

Weight of Perenox per acre in ozs.	TREATMENT.		No. of blisters per leaf.	No. of blisters per leaf. Group Mean.
	Per cent. Perenox.	Volume of spray per acre in galls.		
0.5	0.0625	5	0.865	0.865
1	0.125	5	0.734	0.561
	0.0625	10	0.387	
2	0.25	5	0.458	0.355
	0.125	10	0.397	
	0.0625	20	0.211	
4	0.5	5	0.282	0.221
	0.25	10	0.193	
	0.125	20	0.254	
	0.0625	40	0.155	
8	0.5	10	0.127	0.096
	0.25	20	0.094	
	0.125	40	0.067	
16	0.5	20	0.051	0.069
	0.25	40	0.086	
32	0.5	40	0.031	0.031

Minimum Significant Difference between Treatment Means (5 per cent.) = 0.215.

Treatment means are listed in Table III. They have been arranged in groups, the treatments in each group containing the same amount of Perenox per acre. As might be expected, the heavier dosages give greatly increased control. Within the groups the figures suggest that, for a given application of Perenox, it is better to use a large volume of weak spray

rather than a small volume of concentrated spray. The effect is only significant, however, at the lower levels. Thus 10 gallons per acre of 0.0625 per cent. spray is better than 5 gallons of 0.125 per cent. spray and 20 gallons per acre of 0.0625 per cent. spray is better than 5 gallons of 0.25 per cent. spray.

Means for each group are plotted in Graph I. At applications of less than 2 ozs. per acre the degree of control obtained falls off very rapidly and satisfactory results are not obtained. On the other hand, the highest rates appear to be unnecessary, results being little better with 32 ozs. or 16 ozs. per acre than with 8 ozs. This suggests that the most economical application to give satisfactory control lies between 2 ozs. and 8 ozs. per acre.

Considering the effect of varying the volume of spray applied irrespective of its concentration, there is a significant reduction of infection with increasing volume (Table IV). 40 gallons and 20 gallons per acre do not give significantly different results but both are better than 10 gallons per acre, which in turn is superior to 5 gallons per acre.

Similarly, increasing the concentration of the spray reduces infection. Strengths of 0.5 per cent. and 0.25 per cent. are significantly more effective than strengths of 0.125 per cent. or 0.0625 per cent.

Table IV.

Effect of Varying Strengths and Volumes of Spray.

Strength of Perenox. (per cent.)	Volume of Spray (galls. per acre). 5	10	20	40	Strength Mean.
0.0625	0.865	0.387	0.211	0.155	0.405
0.125	0.734	0.397	0.254	0.067	0.363
0.25	0.458	0.193	0.094	0.086	0.208
0.5	0.282	0.127	0.051	0.031	0.123
Volume Mean	0.585	0.276	0.152	0.085	

Minimum Significant Difference between Means (5 per cent.) = 0.107.

DISCUSSION.

Spraying is an expensive process, both in labour and materials. To cut down costs it is therefore desirable to use as little labour as possible and also the smallest amount of fungicide permissible. Using knapsack sprayers, reducing the volume of spray applied decreases the labour requirements considerably as not only can the spraying of a given acreage be carried out more quickly but the amount of water-carrying can also be reduced. In this connection it does not seem advisable to attempt to reduce the volume to below 10 gallons per acre (in practice it is in any

case difficult to do this efficiently with the equipment at present in use) and an amount of 20 gallons per acre is more satisfactory. On the other hand, volumes higher than 20 gallons per acre are wasteful as they give only slightly increased efficiency.

As regards concentration of fungicide, the figures obtained suggest that the normally used strength of 0.25 per cent. (4 ozs. in 10 gallons) should not be reduced unless a fairly high volume of spray is applied. Concentrations higher than 0.25 per cent. do not generally give improved control and need not be considered.

As was seen from Graph I, the amount of Perenox applied should not be less than 2 ozs. per acre and 4 ozs. or 8 ozs. would give better results. To obtain totals of between 4 ozs. and 8 ozs. the most satisfactory of the dosages used in this experiment would appear to be 10 or 20 gallons per acre of 0.25 per cent. strength or 20 gallons of 0.125 per cent. strength. It has been found that in large-scale spraying 10 to 20 gallons per acre of 0.25 per cent. Perenox gives good control but extensive tests with spray of half that concentration have not yet been made. It is recommended, therefore, that for the present the stronger spray mixture should be used. It is hoped to obtain, by further trials, more information on this point during the wet season towards the end of 1951, when severe blister blight infection is likely to occur.

Summary.

The first experiment demonstrates that five copper sprays gave equally good control of blister blight. A sulphur spray and a copper dust were less effective.

In the second experiment, adequate control was obtained with amounts of Perenox varying from 2 ozs. to 8 ozs. per acre. 10 to 20 gallons per acre of 0.25 per cent. spray appears to be the most satisfactory dosage.

Acknowledgement.

Thanks are due to Mr. D. R. Westgarth, Statistician, Rubber Research Institute of Malaya, for help in the statistical analysis of these experiments.

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WET PADI MECHANICAL CULTIVATION EXPERIMENTS, KELANTAN, SEASON 1950-51

BY

E. J. H. BERWICK,

Acting State Agricultural Officer, Kelantan.

Programme for the 1950-51 Season.

The planting of wet padi in Kelantan, and the object of the mechanical cultivation experiments now being conducted have been described by Ashby (1). The experiments in the previous two seasons have been reported (Ashby (1) and (2)) and this article records the results obtained during the 1950-51 season. Considerable experience with mechanical equipment had been gained in the previous seasons, and the experiments were conducted without difficulty. Fordson, Ferguson and Farmall A tractors were used and the only equipment of non-standard type used was the vaned drum-roller previously described. In this article, therefore, attention is paid mainly to agronomic matters.

Four experiments laid down on medium land with generally good irrigation at Kota Bharu Experiment Station in previous seasons were continued; they were:—

Experiment Kn. 13—Times and depths of ploughing.

Experiment Kn. 13—Depths of after-harvest ploughing and off-season cropping.

Experiment Kn. 28—Wet versus dry cultivation.

Experiment Kn. 29—Effect of methods of cultivation on weed growth.

One new trial was started at the Kota Bharu Experiment Station; it was

Experiment Kn. 42—Type of cultivation and off-season cropping.

Fewer experiments were conducted on smallholders' land than in the previous seasons because manurial trials conducted in 1949-50 had opened new lines of research on which the main effort of the Department had to be concentrated. One experiment was, however, continued, Experiment Kn. 19—times and depths of ploughing, at Salor, on deep land, and one was initiated, Experiment Kn. 51—type of cultivation, varieties and manures, at Bendang Setek, on poor sandy soil.

Some reference will also be made to Experiment Kn. 41, concerning the depth at which manure should be spread in the soil, which, although theoretically a purely manurial experiment, is one which cannot be conducted on a large scale without the use of mechanical equipment.

Experiment Kn. 12—Times and Depth of Ploughing.

This experiment was continued for the third season in succession, no changes being made in times, depths or layout. The only modification

was that all plots were divided into two for a comparison of the effect of weeding against no weeding. A good season was experienced and the yields of padi on some plots were over 500 gantangs per acre.

The dates of starting the cultivation of the different treatments are given below:

A. Deep ploughing, 8 to 10 ins., shortly after harvest, 29th March, 1950.

B. Shallow ploughing, 4 ins., shortly after harvest, 30th March, 1950.

C. Shallow ploughing, 4 ins., shortly before transplanting, 20th September, 1950.

D. Deep ploughing, 8 to 10 ins., usual time, 19th August, 1950.

E. Shallow ploughing, 4 ins., usual time, 19th August, 1950.

F. Kelantan cattle plough, 4 ins., 19th August, 1950.

G. Deep ploughing, 8 to 10 ins., shortly before transplanting, 20th September, 1950.

The seed was sown in nurseries on the 19th August and the seedlings were transplanted on the 28th September, 1950. Weeding was done two months after transplanting; the labour requirements in man days per acre are shown in Table I. Calculating figures for the weeding of small plots is difficult and these figures are absurdly high. No conclusions can be drawn from them. At the same time the plots were marked for evenness of growth and weed control. There is no consistency in the figures, and those for weediness do not appear to be correlated in any way with the labour requirements for removing them. Further research into methods of marking weediness is clearly required.

Table I.

Average Working Times, in Man Days per Acre.

(Experiment Kn. 12.)

	Deep.			Shallow.			Cattle.
	Early.	Normal.	Late.	Early.	Normal.	Late.	Normal.
Weeding	163	149	112	176	104	208	165

At harvest the number of tillers was counted and the plant heights and ear lengths were measured. The sub-treatment means are shown in Table II. With reference to the tiller counts, there is some tendency for deep ploughing to increase tillering, and all the tractor ploughed plots were better than the cattle ploughed plots. Little can be obtained from the figures for plant heights and ear lengths.

Table II.
Tiller Counts, Plant Heights and Ear Lengths.
(Experiment Kn. 12.)

	Deep.			Shallow.			Cattle.
	Early.	Normal.	Late.	Early.	Normal.	Late.	Normal
Tiller counts							
Weeded	8.7	9.4	9.7	8.8	9.1	8.2	7.1
Not weeded	9.1	9.4	8.7	7.6	8.9	9.7	7.1
Mean	8.9	9.4	9.2	8.2	9.0	8.9	7.1
Plant heights (ins.)							
Weeded	41.5	41.4	43.5	42.9	42.6	39.6	39.7
Not weeded	41.9	40.2	41.1	31.1	37.1	42.6	38.4
Mean	41.7	40.8	42.3	37.0	39.8	41.1	39.0
Ear lengths (ins.)							
Weeded	10.1	10.4	10.1	10.3	10.9	10.3	10.3
Not weeded	10.5	11.1	10.7	10.4	10.9	9.6	11.2
Mean	10.3	10.7	10.4	10.3	10.9	9.9	10.7

The yields at harvest are given in Table III. The average yields, in gantangs per acre, are shown in Table IV. It will be seen that there are no significant differences between the main treatments, although it is interesting to see that the shallow ploughed plots did better than the deep, and that all tractor ploughed plots did better than the cattle ploughed ones, although the latter was not the case in previous seasons. Weeding naturally gave significantly greater returns than non-weeding.

Table III.

Yields in Lbs. per Plot of 1/60 Acre.

(Experiment Kn. 12.)

BLOCK I								
Weeded	....	45.2	53.5	40.8	38.5	40.3	43.3	40.5
Not weeded	....	42.0	37.5	35.0	33.5	46.3	41.5	36.0
Mean	....	43.6	45.5	37.9	36.0	43.3	42.4	38.2
BLOCK II								
Weeded	....	35.5	37.3	44.3	41.3	58.3	53.8	39.5
Not weeded	....	25.3	39.5	34.3	44.3	40.3	36.8	25.0
Mean	....	30.4	38.4	39.3	42.8	49.3	45.3	32.2

Table IV.

Average Yields in Gantangs per Acre.

(Experiment Kn. 12.)

	Deep.				Shallow.				Cattle.	
	Early	Normal.	Late.	Mean.	Early	Normal.	Late.	Mean.	Normal.	Mean.
Weeded	418	470	440	443	516	510	502	485	414	414
Not weeded	348	398	358	368	402	448	404	418	315	315
Mean	383	434	399	—	459	479	453	—	364	—

In the 1951-52 season the experiment is to be modified to increase the number of replications and to omit the early and late treatments.

Experiment Kn. 13—Depth of After-Cultivation Ploughing and Off-Season Cropping.

The main treatments in this experiment,

A. deep ploughing, and
B. shallow ploughing,

were continued but the sub-treatments were modified as shown in Table V.

Table V.
Details of Sub-Treatments.
(Experiment Kn. 13.)

Sub-treatment.	1949 season.	1950 season.
P	Natural grass or weeds. Not manured.	Natural grass or weeds. Not manured.
Q	Green manure (dwarf cow-pea). Not manured.	Green Manure (dwarf cow-pea). 2 cwts. rock phosphate per acre.
R	Bare fallow (kept cultivated). Not manured.	Groundnuts, ½ cwt. sulphate of ammonia, 2 cwts. rock phosphate and 10 cwts. limestone per acre.
S	Short bare fallow—followed by groundnuts. 4½ cwts. limestone per acre.	Sweet potatoes, ½ cwt. sulphate of ammonia and 2 cwts. rock phosphate per acre.

Planting of the off-season crops took place on the 4th April, 1950, and establishment of cow-pea and sweet potatoes was fair but that of the groundnuts was poor. Yields per acre, in lbs. of shelled beans in the case of cow-peas and groundnuts and of clean tubers in the case of the sweet potatoes, are given in Table VI.

Table VI.
Yields of Off-Season Crops.
(Experiment Kn. 13.)

	P	Q	R	S
A	—	352	446	5,932
B	—	352	276	5,888
Mean	—	352	361	5,910

It will be seen that none of the yields was good and that, even when watered, crops of only about half average yield can be obtained.

The plots were ploughed on the 23rd August and drum-rolled on the 29th September, 1950. The main-crop padi seed was sown in wet nurseries on the 21st August, the seedlings being transplanted on the 30th September, 1950.

The plots were marked for general growth and for weed control on the 30th November and 13th December, 1950, respectively. Treatment means are shown in Table VII. It will be seen that growth after two months was better on the shallow ploughed plots, and that ten weeks after planting, weed control was better on the deep ploughed than on the shallow ploughed plots.

Table VII.

Marks for General Growth and Weed Control.

(Experiment Kn. 13.)

		P	Q	R	S
General growth	Deep	3.2	3.2	3.2	3.2
	Shallow	38.	3.8	3.8	3.8
Weed control	Deep	7.3	7.0	5.7	6.7
	Shallow	5.0	5.2	5.3	5.2

At harvest the number of tillers was counted and the plant heights and ear lengths measured in inches. The sub-treatment means are shown in Table VIII. The plot figures are very variable and the differences between sub-treatments are obviously insignificant. There is, however, some indication that deep ploughing reduces tillering, and decreases plant height and ear length.

Average yields, in gantangs per acre, are shown in Table IX. Owing to lack of sufficient replications, the differences between treatments are all insignificant. The decrease caused by deep ploughing is interesting.

Experiment Kn. 28—Wet Versus Dry Cultivation.

This experiment was continued for a second year, the treatments being:—

A. Cultivation in the dry and seed dibbled,

B. Cultivation in the dry, followed by flooding and transplanting and

C. Normal wet cultivation.

All operations were conducted without difficulty according to the dates shown in Table X.

A fair season was experienced, although the area suffered from shortage of water on a few occasions.

Table VIII.

Tiller Counts, Plant Heights and Ear Lengths.
(Experiment Kn. 13.)

	P	Q	R	S	Mean.
Tiller counts.					
Deep ploughed	4.2	6.5	7.7	6.8	6.3
Shallow ploughed	8.3	8.2	7.1	7.7	7.8
Mean	6.2	7.3	7.4	7.2	7.0
Plant heights (ins.)					
Deep ploughed	35.3	36.1	37.7	33.5	35.6
Shallow ploughed	38.4	38.7	38.1	38.4	38.4
Mean	36.8	37.4	37.9	35.9	37.0
Ear lengths (ins.)					
Deep ploughed	9.9	10.6	10.6	10.4	10.4
Shallow ploughed	10.8	10.9	10.8	10.5	10.7
Mean	10.3	10.7	10.7	10.4	10.5

Table IX.

Average Yields, in Gantangs per Acre.
(Experiment Kn. 13.)

	P	Q	R	S	Mean.
Deep	269	288	307	274	284
Shallow	341	337	351	317	336
Mean	305	312	329	295	310

Table X.

Dates of Operations, 1950.

(Experiment Kn. 28.)

	A	B	C
Ploughing	1st July	1st Aug.	3rd Aug.
1st harrowing	10th July	27th Aug.	—
1st rolling	—	—	14th Aug.
2nd harrowing	15th July	—	—
2nd rolling	—	—	31st Aug.
3rd harrowing	20th July	—	—
Sown in nursery	—	22nd July	22nd July
Dibbled in field	22nd July	—	—
Transplanted	—	31st Aug.	31st Aug.

The plots were marked for general growth and weed control on the 30th November and the 13th December, 1950, respectively. The treatment means (maximum 10) are shown in Table XI. Normal wet cultivation has done best in growth, and as regards weed control the two transplanted treatments are better than the dibbled.

Table XI.

Marks for General Growth and Weed Control.

(Experiment Kn. 28.)

	A	B	C
General growth	4.4	4.9	6.7
Weed control	4.5	6.1	5.9

At harvest the number of tillers was counted and the plant heights and ear lengths measured in inches. Treatment means are shown in Table XII. Treatment A, dry cultivation, has done very well as regards tillers and is fair in ear length. Treatment B has done badly for height.

Table XII.
Tiller Counts, Plant Heights and Ear Lengths.
(Experiment Kn. 28.)

	A	B	C
Tiller counts	14.8	9.3	9.4
Plant heights (ins.)	45.2	40.7	47.1
Ear lengths (ins.)	10.6	10.2	10.2

The yields per plot at harvest are given in Table XIII, and yields, in gantangs per acre, are given in Table XIV. A statistical analysis of these figures shows that normal wet cultivation is better than the other treatments at the 1 per cent. This is the second season in which this result has been obtained and, as the area is urgently required for manurial trials, the experiment will stop now instead of continuing for a third season as originally proposed.

Table XIII.
Yields, in Lbs. per Plot of 1/20 Acre.
(Experiment Kn. 28.)

Block.	A	B	C	Block Total.
I	90.5	78.8	122.0	291.3
II	91.0	115.8	128.8	335.6
III	51.3	63.8	103.0	218.1
IV	50.0	80.8	117.3	248.1
Total	282.8	339.2	471.1	1,093.1
Treatment Means	70.7	84.8	117.8	—

Table XIV.
Yields, in Gantangs per Acre.
(Experiment Kn. 28.)

	A	B	C	Mean.
Yields, in gantangs per acre	244	292	466	334

Experiment Kn. 29—Effect of Methods of Cultivation on Weed Growth.

This experiment was continued without change for a second year, the treatments being:—

A. Rotary cultivation only.
B. Single ploughing with extensive after cultivation.
C. Single ploughing with minimum after cultivation.
D. Single ploughing with after cultivation to slice rather than invert the soil.
E. Normal Kelantan methods.

The dates on which the various operations were done are shown in Table XV. Sowing of the nurseries took place on the 23rd August and transplanting on the 12th October, 1950. Irrigation on this rather high area was difficult and the experiment never really got a chance and yields were low.

Table XV.
Date of Operations, 1950.
(Experiment Kn. 29.)

	A	B	C	D	E
1st ploughing	23rd Aug. 24th Aug.	22nd Aug. 23rd Aug.	23rd Aug. 24th Aug.	24th Aug.	23rd Aug.
1st harrowing	—	11th Sept.	11th Sept.	13th Sept.	31st Aug.
2nd ploughing	11th Sept.	—	—	—	3rd Sept.
2nd harrowing	—	24th Sept.	17th Sept.	17th Sept.	18th Sept.
3rd ploughing	5th Oct.	—	—	—	2nd Oct.
3rd harrowing	—	—	30th Sept.	—	9th Oct.
Rolling	—	6th Oct. 7th Oct.	—	30th Sept.	—

The plots were marked for general growth and weed control on the 30th November and 13th December, 1951, respectively. Treatment means are given in Table XVI. By both counts, the rotary cultivated and cattle cultivated plots were the worst.

Table XVI.
Marks for General Growth and Weed Control.
(Experiment Kn. 29.)

	A	B	C	D	E
General growth	5.3	6.0	6.3	6.0	5.3
Weed control	4.7	5.5	6.1	5.5	4.9

At harvest the number of tillers was counted and the plant heights and ear lengths measured in inches. Treatment means are given in Table XVII. All these figures, including those for ear lengths, are low and no significance can be attached to them.

Table XVII.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 29.)

	A	B	C	D	E
Tiller counts	6.4	7.2	6.9	6.7	6.9
Plant heights (ins.)	32.4	32.9	34.1	33.7	33.1
Ear lengths (ins.)	9.7	9.8	10.2	8.5	9.6

The plot yields at harvest are shown in Table XVIII, and the average yields, in gantangs per acre, in Table XIX. Statistical analysis of the figures shows that single ploughing with minimum after cultivation treatment, give a significantly better yield of padi than either normal (E) or rotary cultivation (A), and that the difference between the single ploughing with extensive after cultivation (B) and rotary cultivation (A) almost reached significance. Yields, however, were all very low.

Table XVIII.

Yields, in Lbs. per Plot of 1/40 Acre.

(Experiment Kn. 29.)

Block.	A	B	C	D	E
I	21.0	25.3	35.1	28.0	16.1
II	27.4	30.8	45.7	21.0	31.1
III	23.4	37.6	31.3	31.6	24.2
IV	17.6	18.3	35.8	20.5	22.6
V	23.4	45.1	29.0	30.4	22.0
VI	16.2	21.3	30.6	41.0	18.0
Total	129.0	178.4	207.5	172.5	134.0
Mean	21.5	29.7	34.6	28.7	22.3

Table XIX.
Yields, in Gantangs per Acre.
(Experiment Kn. 29.)

	A	B	C	D	E
Yields in gantangs per acre ...	148	205	239	198	154

Experiment Kn. 42—Types of Cultivation and Off-Season Cropping.

This trial was an observational, non-replicated one. An area of a quarter of an acre of even fertility was selected; it was split into two for chiselling versus no chiselling, and then split again for deep versus shallow ploughing. Each plot was then divided into two for manure versus no manure, and on each sub-plot two types of off-season crops, soya beans and gingelly, were sown. The first sowings of each failed to germinate, but with a second sowing of soya beans a fair establishment was obtained.

The yields of the soya beans, in lbs. per acre, are shown in Table XX. These figures are interesting in spite of the generally poor yields. They indicate that, although the overall controlling factor is lack of water, the best plots (deep ploughed, not chiselled and manured, or shallow

Table XX.
Yields of Off-Season Crops, in Lbs. per Acre.
(Experiment Kn. 42.)

Treatment		Chisel.	No Chisel.	
Deep ploughed.	Manure	195.2	230.4	195.2
	No manure	147.2	208.0	
Shallow ploughed.	Manure	230.4	163.2	182.4
	No manure	208.0	128.0	
Mean.		195.2	182.4	
	Manure	204.8		
	No manure	172.8		
	General Mean	188.4		

ploughed, chiselled and manured) gave an 80 per cent. better yield than the control (shallow ploughed, not chiselled and no manure).

Ploughing for the padi crop started on the 18th September and transplanting took place on the 29th September, 1950. The effect of the two types of off-season crops was negligible througout the season. At harvest, the number of tillers was counted and the plant heights and ear lengths measured in inches. Treatment means are given in Table XXI. In these unreplicated plots, little significance can be attached to these figures. Deep ploughing does seem to have decreased tillering.

Table XXI.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 42.)

	Deep ploughed.		Shallow ploughed.	
	Chisel.	No chisel.	Chisel.	No chisel.
Tiller counts				
Manure	9.0	9.1	12.5	11.6
No manure	10.6	10.5	9.4	11.7
Mean	9.8	9.8	10.9	11.6
Plant heights (ins.)				
Manure	40.7	41.2	42.7	48.1
No manure	44.0	44.8	36.4	48.4
Mean	42.3	43.0	39.5	48.2
Ear lengths (ins.)				
Manure	10.4	10.4	11.0	10.9
No manure	10.8	10.9	10.7	11.3
Mean	10.6	10.6	10.8	11.1

The yields at harvest are given in Table XXII and the yields, in gantangs per acre, are shown in Table XXIII. There are indications that shallow ploughing is better than deep ploughing and that chiselling is not likely to give any greatly increased yield.

Table XXII.
Yields of Padi, in Lbs. per Total of Two Plots of 1/60 Acre.
(Experiment Kn. 42.)

		Manure.	No Manure.	Mean.
Deep ploughing.	Chisel	751	938	844
	No chisel	803	826	814
Shallow ploughing.	Chisel	892	997	944
	No chisel	1,107	1,047	1,077
Mean.		888	952	

Table XXIII.
Yields, in Gantangs per Acre.
(Experiment Kn. 42.)

	Deep ploughed.		Shallow ploughed.		Mean.
	Chisel.	No chisel.	Chisel.	No chisel.	
Manure	388	415	461	573	459
No manure	485	427	516	542	492
Mean	436	421	488	559	
	429		523		
Chisel 462					
No chisel 489					

As no large increase in yield has been caused by chiselling, this observation trial will not be continued in 1951-52.

Experiment Kn. 19—Times and Depths of Ploughing, Salor.

This experiment is similar to Experiment Kn. 12, described above, as regards cultivation treatments, but in 1950-51 manurial treatments were added. These consisted of a standard dressing to half of each plot at ploughing, and an additional top dressing, applied immediately before transplanting, to half plots in one of the two plots. The cultivation operations and the spreading of the manures were conducted satisfactorily but later the experiment, which is on smallholders land not directly under

Departmental control, met with a series of disasters. A considerable amount of soil from two plots was removed to repair a road nearby with the result that a deep hole was made. This caused water control to be even more difficult than usual and the periodical rush of water from the plots into the hole clearly took with it much of the manure. Nothing can be learnt from it, except that it is difficult to conduct experiments satisfactorily on other peoples' land.

Experiment Kn. 51—Types of Cultivation, Varieties and Manures, Bendang Setek.

This experiment was conducted in an area of very sandy soil on smallholders' land at Bendang Setek. It consisted of four blocks, split into two for shallow tractor ploughing (T) versus cattle ploughing (C), split again for the standard manurial dressing (M) versus no manure (O) and then each plot was divided into three for the three padi varieties, Seraup Besar 15 (X), Radin Siak 34 (Y) and Taichu 65 (Z). All proceeded according to plan, except that the Taichu 65, a very short variety, was severely damaged, firstly by floods and later by ducks, and gave no yield worth recording.

The average number of tillers per plant at harvest is given in Table XXIV. These figures clearly show that there is no difference between the tractor and cattle ploughed plots and that the manure has increased tillering.

Table XXIV.
Average Number of Tillers per Plant at Harvest.
(Experiment Kn. 51.)

Tractor ploughed	Manured	X	8.7	8.2	6.1
		Y	7.7		
	Not manured	X	4.2	4.1	
		Y	4.0		
Cattle ploughed	Manured	X	8.7	8.2	6.2
		Y	7.7		
	Not manured	X	3.0	4.2	
		Y	5..5		

The average yield was 190 gantangs per acre, the average for the manured plots being 291 and the unmanured 88 gantangs per acre. This increase of 203 gantangs per acre or 231 per cent. gives an increased return of $121.80 per acre, while the manures cost $60 per acre.

The treatment yields, in gantangs per acre, are given in Table XXV. It will be seen that almost half of the total variance has been caused by the manurial treatment, which is highly significant. There is no difference between tractor and cattle ploughing although the interaction between cultivation and manuring is significant, tractor ploughing doing best when manured, and cattle ploughing, when unmanured, doing better than the tractor ploughing. There is no difference between varieties but the interaction between varieties and manure were significant, indicating that the long term padi Seraup Besar 15, gave a comparatively greater response to the manure than did the Radin Siak.

Table XXV.

Yields in Gantangs per Acre.

(Experiment Kn. 51.)

Tractor ploughed	Manured	X	340	307	190
		Y	274		
	Not manured	X	67	74	
		Y	81		
Cattle ploughed	Manured	X	301	276	189
		Y	252		
	Not manured	X	84	102	
		Y	120		

Experiment Kn. 41—Manures Applied at Different Depths.

Some reference must be made here to this experiment, as without the aid of mechanical equipment it could not have been conducted. It consisted of four randomised blocks, each of four plots for the following treatments:—

A. Manure spread and ploughed in some 8 ins. below the surface.

B. Half the manure ploughed in and half disced in on the surface.

C. Manure spread on the surface and disced in.

D. No manure.

Ploughing took place on the 14th and 15th August, 1950, and the seedlings were transplanted on the 29th September, 1950. Growth was good on all plots, probably owing to extremely good water control combined with the deep ploughing, and weeding was unnecessary.

The plots were marked for evenness of growth two months after transplanting. Treatment means are given in Table XXVI. All manured plots are better than the unmanured, and those with the manure on the surface are better than those with it below.

Table XXVI.

Marks for Evenness of Growth.

(Experiment Kn. 41.)

	A	B	C	D
Evenness of growth	70	85	91	54

The number of tillers was counted and the plant heights and ear lengths measured in inches. The treatment means are shown in Table XXVII. Manuring has increased the number of tillers per plant and the plant heights. There is no significance in the ear lengths.

Table XXVII.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 41.)

	A	B	C	D
Tiller counts	10.2	12.5	10.9	8.5
Plant heights (ins.)	46.5	47.0	48.3	41.3
Ear lengths (ins.)	10.3	10.8	10.3	10.3

Average yields, in gantangs per acre, are shown in Table XXVIII. Manuring has increased yield by an average of 27 per cent. The difference just misses significance at the 5 per cent. point by Z, but by t, A, B and C are greater than D. It is clear that with a larger number of replications, significance would have been reached. There are no differences between the methods of applying the manures.

Table XXVIII.

Average Yields, in Gantangs per Acre.

(Experiment Kn. 41.)

	A	B	C	D
Yields, in gantangs per acre	423	410	415	329

The experiment will be continued in 1951-52, the manures being applied again.

Analysis of Results.

Although few significant results have been obtained in these experiments, it is useful to consider each stage in the growth of the padi and to ascertain to what extent any trend that may be is constant in all experiments. Evidence from all the experiments previously described is summarised below, the figures in brackets denoting the particular experiment.

Growth in the Early Stages.

Growth was improved by shallow ploughing rather than deep (Kn. 13), and by tractor ploughing rather than cattle ploughing or rotary methods (Kn. 29). Normal methods of wet padi planting resulted in better growth than cultivation in the dry (Kn. 28). Manuring improved growth, especially when near the surface (Kn. 41).

Weed Control.

Weed control was better with deep ploughing (Kn. 13) and where tractor ploughed rather than cattle ploughed or rotary cultivated (Kn. 29). Wet methods of cultivation resulted in better weed control than dry (Kn. 28).

Tillering.

Tillering is improved by deep ploughing in Experiment Kn. 12, but reduced by it in Experiments Kn. 13 and 42. All tractor ploughed plots are better than the cattle ploughed (Kn. 12), and manuring encouraged tillering (Kn. 41 and 51). It is interesting to see that dry cultivation and dibbling resulted in a large number of tillers (Kn. 28).

Plant Height.

Little evidence of any value arose, although deep ploughing has decreased it in one case (Kn. 13).

Ear Length.

Ear length is decreased by deep ploughing (Kn. 13) and increased by manuring (Kn.41).

Yields.

Shallow ploughing tends to be better than deep (Kn. 12, 13, 42), and tractor ploughing better than cattle ploughing (Kn. 12 and 29), especially when manured (Kn. 51), and rotary cultivation (Kn. 29). Normal wet cultivation methods are better than cultivation in the dry and dibbling or transplanting (Kn. 28). Chiselling is unlikely to increase yields (Kn. 42). Yields are increased by manuring (Kn. 41, 51) and by weeding (Kn. 12).

The main difficulty in conducting mechanical cultivation experiments in Kelantan had always been lack of sufficient space, and all the experiments have too few replications. That is the reason why so few significant results have been obtained. Little has therefore been definitely proved. It is becoming clear, however, that provided deep ploughing is not done, tractor ploughing is no worse and infact tends to be rather better than cattle ploughing. The increases caused by manuring are, however, far greater on most of the Kelantan soils, and all experiments in future should have manurial trials incorporated in them.

Summary.

The data obtained in eight wet padi experiments during the season 1950-51 are reported and the results analysed. Although few significant results were obtained, it is becoming clear that, provided deep ploughing is not done, tractor ploughing tends to be as good or better than cattle ploughing. However, it causes no large increases in yield such as are obtained by manuring.

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The experiments were laid down according to the instructions given by Mr. H. K. Ashby, State Agricultural Officer, Kelantan. The writer wishes to acknowledge the efficient work of the staff of the Department who were engaged in the execution and recording of the experimental work, and in particular to Che' Hussin bin Isa, Agricultural Subordinate, Special Grade, in charge of the Kota Bharu Experiment Station, and to the workshop crew who maintained the tractors.

References.

1. ASHBY H. K. Wet Padi Mechanical Cultivation Experiments in Kelantan, Season 1948-1949. *Malayan Agricultural Journal,* Vol. XXXII, July, 1949.

2. ASHBY H. K. 1950 (article not yet published).

DRY PADI MECHANICAL CULTIVATION EXPERIMENTS, KELANTAN, SEASON 1950-51

BY

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Programme for the 1950-51 Season.

The planting of dry padi in Kelantan, and the object of the mechanical cultivation experiments now being conducted have been described by Ashby (1). The experiments in the previous two seasons have been reported (Ashby (1) and (2)) and this article records the results obtained during the 1950-51 season. Experience gained in the previous seasons enabled the experiments to be conducted without mechanical difficulties, Fordson and Ferguson tractors with standard equipment being used. Less attention is therefore paid to mechanical problems, which as regards cultivation and sowing may be considered to have been broadly solved. Three experiments were continued; they were:—

Experiment Kn. 14—Times and depths of cultivation.

Experiment Kn. 15—Depth of cultivation and off-season crops.

Experiment Kn. 21—Drill trials.

Two new trials were initiated;

Experiment Kn. 37—An observation trial on cultivation, manuring and off-season crops.

Experiment Kn. 38—An observation trial on times and depth of ploughing, plus manuring.

Some references will also be made to Experiment Kn. 39, concerning the depth at which manure should be placed, which, although theoretically a purely manurial experiment, is one which cannot be conducted on a large scale without the use of mechanical equipment.

Experiment Kn. 14—Times and Depth of Cultivation.

This experiment was continued for the third season in succession, no changes being made in times, depths or layout. The only modification was that all plots were divided into two for a comparison of the effect of weeding (and intercultivation) against no weeding (and no intercultivation). The season was rather late but cultivation times were accurately adhered to and the land was ready for planting on the 31st July, 1950.

Hand-weeding and supplying started on the 26th August. The treatment means in man hours per acre are shown in Table I. It will be seen that early ploughing has made weeding cheaper, especially when done deeply. Little can be learnt from the figures relating to supplying.

Table I.

Treatment Means in Man-Hours per Acre.

(Experiment Kn. 14.)

Treatment.	Deep.			Shallow.			Cattle.
	Early.	Normal.	Late.	Early.	Normal.	Late.	Normal.
Weeding	67.9	75.9	90.4	75.9	87.9	87.9	87.9
Supplying	57.9	73.9	47.9	50.6	41.3	50.6	47.9

Penetration tests were made at dibbling and weeding. Treatment means, in inches, are shown in Table II. It will be seen that the deep ploughing was satisfactorily done to a depth of 8 to 9 ins., that is to say 4 ins. deeper than the shallow ploughing. Consolidation to the extent of about ¾ in. took place in the month between dibbling and weeding.

Table II.

Mean Depths of Penetration, in Inches.

(Experiment Kn. 14.)

Treatment.	Deep.			Shallow.			Cattle.
	Early.	Normal	Late.	Early.	Normal.	Late.	Normal.
At dibbling	8.8	8.7	8.9	5.6	5.5	5.5	5.5
At weeding	8.1	8.1	8.2	5.0	4.9	4.9	4.8

The plots were marked on the 5th October and 6th November, 1950, for evenness, colour and weed control; the sub-treatment means are shown in Table III. It will be seen that early ploughing produces unevenness and lack of good leaf colour, which are accentuated when the ploughing is deep. It is, however, very effective in controlling weeds.

At harvest the number of tillers was counted and the plant heights and ear lengths measured in inches. The sub-treatment means are shown in Table IV. With reference to the tiller counts, it will be seen that early ploughing has depressed tillering. It is interesting but probably of little significance that the plants which tillered the best were in the shallow ploughed, normal time plots. No weeding naturally decreased the number of tillers. With reference to plant height, deep ploughing has increased the general height, and early ploughing decreased it. Not weeding generally decreased the height of the plants. As regards ear length, deep ploughing has increased it but apart from this there is little difference between treatments.

Table III.

Treatment Means of Marks for Evenness, Colour and Weed Control.
(Maximum 10). (Experiment Kn. 14.)

5th October, 1950.	Deep.			Shallow.			Cattle.
	Early.	Normal.	Late.	Early.	Normal.	Late.	Normal.
Evenness.							
Weeded	2.5	4.7	6.0	4.0	7.0	6.2	5.0
Not weeded	2.5	4.7	6.0	4.0	7.0	6.2	5.0
Mean	2.5	4.7	6.0	4.0	7.0	6.2	5.0
Colour.							
Weeded	2.5	4.7	6.2	4.0	6.7	6.5	6.0
Not weeded	2.5	4.7	6.2	4.0	6.7	6.5	6.0
Mean	2.5	4.7	6.2	4.0	6.7	6.5	6.0
Weed Control.							
Weeded	9.0	8.0	8.0	8.0	7.0	7.0	7.0
Not weeded	8.0	7.0	6.0	7.0	4.0	3.0	2.7
Mean	8.5	7.5	7.0	7.5	5.5	5.0	4.8
6th November, 1950.							
Evenness.							
Weeded	3.7	5.2	7.0	4.2	8.0	7.0	7.2
Not weeded	3.2	5.2	7.0	4.0	8.0	7.0	7.2
Mean	3.5	5.2	7.0	4.1	8.0	7.0	7.2
Colour.							
Weeded	2.5	5.2	6.0	4.0	6.0	6.2	6.0
Not weeded	2.5	4.2	6.0	3.2	5.5	5.2	5.0
Mean	2.5	4.7	6.0	3.6	5.7	5.7	5.5
Weed Control.							
Weeded	8.0	8.0	7.0	7.2	7.0	6.0	6.0
Not weeded	7.0	6.0	3.0	6.5	3.0	2.0	2.0
Mean	7.5	7.0	5.0	6.8	5.0	4.0	4.0

Table IV.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 14.)

	Deep.			Shallow.			Cattle.
	Early.	Normal.	Late.	Early.	Normal.	Late.	Normal
Tiller counts.							
Weeded	5.4	7.2	8.1	7.2	9.1	8.1	7.1
Not weeded	4.8	6.9	7.9	6.3	8.1	7.7	7.5
Mean	5.1	7.0	8.0	6.7	8.6	7.9	7.3
Plant heights (ins.)							
Weeded	37.2	39.7	41.6	37.8	40.1	38.1	37.1
Not weeded	37.8	38.7	38.2	34.5	37.0	34.7	35.4
Mean	37.5	39.2	39.9	36.1	38.5	36.4	36.2
Ear lengths (ins.)							
Weeded	8.7	8.8	8.9	8.3	8.7	8.5	8.5
Not weeded	8.8	8.6	8.8	8.3	8.5	8.1	8.2
Mean	8.7	8.7	8.8	8.3	8.6	8.3	8.3

The yields at harvest are given in Table V. Average yields, in gantangs per acre, are shown in Table VI. These figures emphasise the lowness of the yields. It will be seen that there are significant differences among the main treatments and the sub-treatments. Early ploughing, whether shallow or deep, is bad. Tractor ploughing when done at the normal time or later is better than cattle ploughing. Weeding naturally gives a better return than not weeding but the general interaction, though considerable, does not reach significance. It is clear, however, that deep ploughing reduces the decrease caused by not weeding.

It is clear that the fertility on this area is now very low. In the 1951-52 season a general dressing of fertilisers will be given and the whole area shallow ploughed.

Experiment Kn. 15—Depth of Cultivation and Off-Season Cropping.

The main treatments in this experiment,

(A) Deep ploughing and

(B) Shallow ploughing,

were continued but the sub-treatments were modified as shown in Table VII.

Table V.

Yields in Lbs. per Plot of 1/16 Acre.

(Experiment Kn. 14.)

Block.	I		II		III		IV	
	X	Y	X	Y	X	Y	X	Y
A	4	2	9	14	3	2	12	8
B	10	1	28	26	6	8	15	7
C	24	8	23	17	24	12	32	14
D	14	6	36	36	24	13	28	15
E	32	27	33	17	26	11	31	13
F	38	21	23	8	17	14	15	8
G	32	23	30	35	28	18	27	16

Table VI.

Average Yields, in Gantangs per Acre.

(Experiment Kn. 14.)

	Deep.				Shallow.				Cattle.	
	Early.	Normal.	Late.	Mean.	Early	Normal.	Late.	Mean.	Normal	Mean
Weeded	19	69	78	55	35	81	65	60	62	62
Not weeded	17	46	62	42	28	46	33	36	34	34
Mean	18	57	70	—	31	63	49	—	48	—
	48				48				48	

Planting took place between the 18th and 21st of March, 1950, but the weather later was not favourable. As water is not normally available on dry padi land, no watering was done and growth was poor. The average yields, in lbs. per acre, are given in Table VIII. It will be seen that yields were very low and that deep ploughing has caused a significant increase in yield, especially with the dwarf cow-pea.

Table VII.

Details of Sub-treatments.

(Experiment Kn. 15.)

Sub-treatment.	1949	1950
P	Natural grass or weeds. Not manured.	Natural grass or weeds. Not manured.
Q	Green manure (dwarf cowpea). Not manured.	Green manure (dwarf cowpea). Manured with 2 cwts. rock phosphate and 10 cwts. limestone per acre.
R	Bare fallow. Not manured.	Groundnuts. Manured with ½ cwt. of sulphate of ammonia, 2 cwts. rock phosphate and 10 cwts. limestone per acre.
S	Short term crop of Lady's Fingers. Manured with cattle manure at 1½ tons per acre.	Sweet potatoes. Manured with ½ cwt. sulphate of ammonia, and 2 cwts. rock phosphate per acre.

Table VIII.

Yields of Off-season Crops in Lbs. per Acre.

(Experiment Kn. 15.)

Treatment.	Q (Dwarf cowpea).	R (Groundnuts).	S (Sweet potatoes).
Deep	222	390	1,020
Shallow	114	315	678
Mean	168.0	352.5	849.0

Ploughing took place from the 9th to 11th July and planting took place on the 1st August, 1950. Penetration tests were made at dibbling and weeding. Treatment means, in inches, are shown in Table IX. It will be seen that deep cultivation was satisfactorily done at 3 to 3½ ins. more than the shallow cultivation. Consolidation in this experiment was greater than in Experiment Kn. 14.

Table IX.

Penetration Means at Planting and Weeding, in Inches.

(Experiment Kn. 15.)

Treatment.	Deep.				Shallow.			
	P	Q	R	S	P	Q	R	S
At planting	8.8	8.8	8.7	8.7	5.4	5.4	5.4	5.4
At weeding	7.5	7.5	7.5	7.5	4.6	4.5	4.5	4.6

The plots were marked on the 5th October and again on the 7th November, 1950, for evenness, colour and weed control. The sub-treatment means are shown in Table X. It will be seen that deep ploughing plus manures improves evenness, colour and weed control, and that sub-treatment P, on which no off-season crops were grown, is the worst of the sub-treatments for evenness and colour but highly satisfactory for weed control.

At harvest, the number of tillers was counted and the plant heights and ear lengths measured in inches. The treatment means are shown in Table XI. These figures are interesting and compare well. Deep ploughing will increase tillering, especially when the off-season growth has been manured. Treatment P, which is virtually early ploughing, is bad, as in Experiment Kn. 14. With regard to plant heights, deep ploughing increases them to an extent which cannot be compensated for by off-season manuring, and similar figures occur for ear length.

Average yields, in gantangs per acre, are shown in Table XII. It will be seen that there are significant differences among the main treatments and the sub-treatments. Deep ploughing has increased the yield by some 46 per cent. Among the sub-treatments, Q and S were superior to P at 5 per cent. and Q was superior to P at 1 per cent. It seems likely that the increase in yield in the case of Q and S is caused not only by artificial fertilisers but also by green matter ploughed in. The interaction very nearly reaches significance. These results confirm those of previous seasons.

Table X.

Marks for Evenness, Leaf Colour and Weed Control.

(Maximum 10). (Experiment Kn. 15.)

5th October, 1950.	P	Q	R	S	Mean.
Evenness.					
Deep	4.4	7.1	7.0	6.9	6.3
Shallow	3.9	6.4	6.9	6.9	6.0
Colour.					
Deep	4.6	7.0	6.9	6.6	6.3
Shallow	4.9	5.6	5.4	5.3	5.3
Weed control.					
Deep	9.0	8.0	7.7	6.4	7.8
Shallow	7.1	5.3	5.5	5.5	5.8
7th November, 1950.					
Evenness.					
Deep	4.4	7.1	7.0	6.9	6.3
Shallow	4.9	6.4	6.9	6.9	6.3
Colour.					
Deep	7.6	6.0	5.9	5.7	6.3
Shallow	7.0	4.8	4.0	4.5	5.1
Weed control.					
Deep	8.0	7.0	6.8	7.0	7.2
Shallow	6.1	4.3	4.5	4.5	4.8

Experiment Kn. 21—Drill Trials.

The experiment was conducted in a similar manner to the previous seasons with the exception that treatment H, drilling at 12 ins. spacing with a Trusty Tractor, was omitted. This experiment was excluded as it had been decided that no further experiment work should be conducted on dry padi with horticultural tractors. The cultivations started on the 2nd May and drilling took place on the 22nd July, 1950. A fair season was experienced but yields were low because the area had received no manure for many years.

Table XI.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 15.)

Treatment.	Deep.				Shallow.			
	P	Q	R	S	P	Q	R	S
Tiller counts	8.2	9.4	9.9	9.6	8.3	8.4	9.0	9.4
Plant heights (ins.)	42.9	48.7	47.5	57.6	41.6	42.0	42.0	43.8
Ear lengths (ins.)	8.7	9.0	9.0	9.1	8.5	8.4	8.4	8.6

Table XII.

Yields, in Gantangs per Acre.

(Experiment Kn. 15.)

Treatment.	P	Q	R	S	Mean.
Deep	95	162	133	141	133
Shallow	91	95	81	97	91
Mean	93	128	107	119	—

For ease of reference the treatments are shown below.

A. 21 ins. higher seedrate, i.e. 10 lbs. per acre.
B. 7 ins higher seedrate, i.e. 25.3 lbs. per acre.
C. Normal Kelantan methods, i.e. dibbling.
D. 14 ins. lower seedrate, i.e. 9.2 lbs. per acre.
E. 7 ins. lower seedrate, i.e. 21.8 lbs. per acre.
F. 14 ins. higher seedrate, i.e. 15.9 lbs. per acre.
G. 21 ins. lower seedrate, i.e. 6.2 lbs. per acre.

The plots were marked, on the 5th October and 7th November, 1950, for evenness, colour and weed control. The sub-treatment means are shown in Table XIII. It will be seen that as regards evenness of growth, those plots drilled at 7 ins. spacing were the best and that the higher seedrate was generally better than the lower. With reference to colour, the variance of the figures was high and probably the only fact of significance is that at the later date the closely drilled plots were bad for colour. There was no difference in weed control at the time of the first marking but at the time of the second, the closely drilled plots were the best.

Table XIII.

Marks for Evenness, Leaf Colour and Weed Control.
(Maximum 10). (Experiment Kn. 21.)

5th October, 1950.	A (21 H)	B (7 H)	C (C)	D (14 L)	E (7 L)	F (14 H)	G (21 L)	Mean.
Evenness	5.0	5.5	4.0	4.0	5.2	4.7	4.7	4.7
Colour	4.7	5.0	4.0	4.2	4.5	4.7	5.2	4.6
Weed control	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
7th November, 1950.								
Evenness	5.5	6.5	5.5	5.0	6.2	5.7	5.7	5.7
Colour	5.0	4.5	5.0	5.2	4.5	5.0	5.7	5.0
Weed control	6.0	7.0	6.0	6.0	7.0	6.0	6.0	6.3

Average yields, in gantangs per acre, are shown in Table XIV. The analysis of variance shows that the difference between the treatments is significant at the 1 per cent. point. It will be seen that, in general, the closer the drills the better, and also the higher the seed-rate the better. The exception is in the case of the 21 ins. spacing but here the difference is not significant. These results are similar to the general trend of previous seasons.

Table XIV.

Yields, in Gantangs per Acre.
(Experiment Kn. 21.)

Treatment.	Higher seed-rate.	Lower seed-rate.
21 ins. spacing	63	72
14 ins. spacing	83	58
7 ins. spacing	110	100
Dibbled	73	

Experiment Kn. 37—Cultivation and Off-Season Crops.

This trial was observational and non-replicated. An area of half an acre of even fertility was selected; it was divided, in a north-south direction, into two for chisel and no chisel and then divided in an east-west direction for deep and shallow ploughing. Each plot was then split

into sub-plots for manure and no manure, and four types of off-season crops were grown on each sub-plot.

The trial was planted according to plan, attempts being made to grow soya beans, stylosanthes, gingelly and twelve varieties of short term dry padi. Cuttings of stylosanthes were planted on the 26th March, 1950, seed of the remainder being sown on the previous day. As water is not normally available on dry padi areas, watering was not carried out and no good crops were obtained.

Ploughing for the main padi crop started on the 12th July and dibbling took place on the 11th September, 1950. The off-season crops were so poor that their effects may be considered to be negligible, and the experiment resolved itself into a simple trial of deep versus shallow ploughing, chiselling versus no chiselling and manuring versus no manuring.

The plots were marked, on the 4th October and 11th November, 1950, for evenness of growth, colour and weed control. The figures were very variable and so nothing of value could be gained from them.

Table XV.

Tiller Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 37.)

	Deep ploughed.		Shallow ploughed.	
	Chisel.	No chisel.	Chisel.	No chisel.
Tiller counts.				
Manure	11.2	13.1	10.3	11.9
No manure	10.7	11.8	12.3	11.5
Mean	10.9	12.4	11.3	11.7
Plant heights (ins.)				
Manure	51.7	53.2	46.9	49.4
No manure	44.7	47.0	45.6	43.7
Mean	48.2	50.1	46.2	46.5
Ear lengths (ins.)				
Manure	9.3	9.4	9.2	9.2
No manure	9.1	9.2	9.2	9.1
Mean	9.2	9.3	9.2	9.1

At harvest, the number of tillers was counted and the plant heights and ear lengths measured in inches. The treatment means are shown in Table XV. Too much must not be drawn from these figures, but it is clear that the greatest difference has been caused by manures, that deep ploughing tends to be better than shallow, and that chiselling does not cause any large advantage for good growth, except possibly with shallow ploughing.

Table XVI.

Yields, in Lbs. per Total of Four Plots of 1/120 Acre.

(Experiment Kn. 37.)

		Manure.	No manure.	Mean.	Chisel.	No chisel.	Mean.
Deep ploughed	Chisel	36.1	27.7	31.9	31.9	44.2	38.0
	No chisel	50.0	38.5	44.2	25.9	27.3	26.6
Shallow ploughed	Chisel	25.4	26.5	25.9	28.9	35.7	—
	No chisel	33.1	21.5	27.3	—	—	—
Mean		36.1	28.5	—	—	—	—

Table XVII.

Yields, in Gantangs per Acre.

(Experiment Kn. 37.)

	Deep ploughed.		Shallow ploughed.		Mean.
	Chisel.	No chisel.	Chisel.	No chisel.	
Manure	180	250	127	166	181
No manure	138	193	133	108	143
Mean	159	211	130	137	—
	190		133		

The yields at harvest are given in Table XVI and the average yields, in gantangs per acre, are shown in Table XVII. It is clear that deep ploughing has done better than shallow ploughing, that manuring the off-season crops has improved the padi crop, and that chiselling is unlikely to be of great value except possibly when shallow ploughing only is done. It has been shown that off-season crops are unlikely to be of any value unless water is available and that chiselling is unlikely to increase yields to any marked degree on these soils. This observation trial will not, therefore, be continued.

Experiment Kn. 38—Times and Depths of Ploughing Plus Manures.

This was an unreplicated trial, designed to observe the effect of depth and time of cultivation, including a comparison of the effect of a complete artificial manure being partly taken up in the off-season growth and returned again to the soil.

The treatments were:—

A. Early deep ploughing.
B. Early shallow ploughing.
C. Late shallow ploughing.
D. Normal deep ploughing.
E. Normal shallow ploughing.
G. Late deep ploughing.
F & H. Kelantan methods, normal time.

All plots, except H, received the standard dressing (2 cwts. sulphate of ammonia : 2 cwts. of concentrated superphosphate : ¾ cwt. muriate of potash) at the time of first ploughing. Half of each plot, except H, received a late dressing (2 : 1 : ¼), half below the surface at the time of the last ploughing and half on the surface before dibbling.

A fair season was experienced and the cultivations were conducted according to plan, dibbling finally taking place on the 1st August, 1950.

Table XVIII.

Plot Records, in Man Hours per Acre.

(Experiment Kn. 38.)

	Deep.			Shallow.			Cattle. Normal.	
	Early.	Normal	Late.	Early.	Normal	Late.		
Weeding.								
No late manure	100	87	127	80	93	93	93	83
Late manure	127	100	87	113	87	127	113	—
Supplying.								
No late manure	20	40	40	6	6	20	20	23
Late manure	32	26	40	20	13	26	26	—

Table XIX.

Mean Depths of Penetration, in Inches.
(Experiment Kn. 38.)

	Deep.			Shallow.			Normal. Cattle.	
	Early.	Normal	Late.	Early.	Normal	Late.		
At dibbling	9.1	8.5	9.6	6.6	5.7	5.7	5.5	5.7
At weeding	8.6	8.4	8.7	5.2	5.3	5.3	5.2	5.3

Table XX.

Marks for Evenness, Leaf Colour and Weed Control.
(Maximum 10.) (Experiment Kn. 38.)

4th October, 1950.	Deep.			Shallow.			Cattle. Normal.	
	Early.	Normal	Late.	Early.	Normal	Late.		
Evenness.								
No late manure	7	8	9	8	8	8	7	5
Late manure	7	8	9	8	8	8	7	—
Colour.								
No late manure	9	9	8	9	7	6	8	6
Late manure	9	9	9	9	9	8	9	—
Weed control.								
No late manure	8	8	6	6	6	5	6	7
Late manure	8	7	6	6	6	6	6	—
7th November, 1950.								
Evenness.								
No late manure	8	9	10	8	8	8	7	5
Late manure	9	10	10	9	9	9	8	—
Colour.								
No late manure	6	7	7	6	5	4	5	5
Late manure	8	8	7	7	6	6	6	—
Weed control.								
No late manure	7	7	6	6	5	4	4	6
Late manure	7	7	6	6	5	4	4	—

Hand weeding and supplying were done from the 17th to the 19th September and on the 30th September, 1950, respectively. The plot records in man hours per acre are shown in Table XVIII. Except that shallow ploughing has decreased the cost of supplying, little can be gained from these figures.

Penetration tests were made at dibbling and weeding. Means, in inches, are shown in Table XIX. These figures merely show that the cultivations were satisfactorily prepared.

The plots were marked on the 4th October and 7th November, 1950, for evenness, colour and weed control, and these figures are shown in Table XX. As regards evenness of growth, late deep ploughing gives the best results and cattle ploughing is less effective than tractor ploughing. The late dressing of manure causes little difference for the first six or seven weeks. With reference to colour, deep ploughing (and deep placement of manure) does best. With reference to weed control, deep and early ploughing does best.

At harvest, the number of tillers was counted, and the plant heights and ear lengths measured in inches. The treatment means are shown in Table XXI. These figures (the trials were not replicated) tend to show that tillering can be increased by deep ploughing and manuring at the time of first ploughing. The second application of manure has increased the number of tillers only in the cattle ploughed plots. The early ploughing and placement of manure has increased plant heights; the second application of manure has had little effect except in the cattle ploughed plot. The variance in the ear lengths is so great that conclusions are impossible.

Table XXI.

Tillers Counts, Plant Heights and Ear Lengths.

(Experiment Kn. 38.)

	Deep.			Shallow.			Cattle. Normal.	
	Early.	Normal	Late.	Early.	Normal	Late.		
Tiller counts.								
No late manure	11.2	15.5	11.5	13.3	12.8	9.3	9.9	8.1
Late manure	13.0	12.5	11.8	12.4	11.9	9.6	14.2	—
Plant heights (ins.).								
No late manure	66.8	66.0	60.7	63.0	64.9	46.0	47.2	39.6
Late manure	65.2	63.5	62.2	65.8	64.5	58.1	61.6	—
Ear lengths (ins.).								
No late manure	9.1	9.6	10.2	9.6	10.1	9.0	9.0	9.2
Late manure	9.9	10.4	9.8	10.0	10.1	9.1	10.5	—

The yields, expressed in gantangs per acre, are shown in Table XXII. These figures (which are plot yields, not replicated) are especially interesting as they show to an almost convincing extent that, if manures are put in at the time of first ploughing, it pays to plough early. The later dressing has had less effect except in the case of the cattle ploughed plot. They confirm the general idea that dry padi, unmanured, gives about 100 gantangs per acre, manured, up to 200 and deep ploughed and manured 225 to 275 gantangs per acre.

Table XXII
Yields, in Gantangs per Acre.
(Experiment Kn. 38.)

	Deep.			Shallow.			Cattle. Normal.	
	Early.	Normal	Late.	Early.	Normal	Late.		
No late manure	235	225	210	210	170	116	114	103
Late manure	269	266	217	223	204	150	180	—

Experiment Kn. 39—Manures Applied at Different Depths.

Some reference must be made here to this experiment. It consisted of four randomised blocks, each of four plots, for the following treatments:

A. Control—no manure.

B. A standard dressing of artificial manure applied to the surface of the soil before ploughing. The manure was, therefore, placed at the bottom of the furrow slice.

C. Half the manure applied to the surface of the soil before ploughing and half applied before harrowing. Some manure was, therefore, at the bottom of the furrow slice and some near the surface.

D. The manure was applied after ploughing and before harrowing. It was all, therefore, near the surface.

Table XXIII.
Marks for Evenness, Leaf Colour and Weed Control.
(Experiment Kn. 39.)

Treatment	Evenness of growth.	Colour.	Weed control.
A	9	10	24
B	14	20	24
C	14	23	24
D	21	28	24

Dibbling by normal Kelantan methods took place on the 29th July, 1950. On the 3rd September, the plots were marked for evenness of growth, colour and weed control. The treatment totals are shown in Table XXIII. D was better than C and B as regards evenness of growth and colour, and C and B were, in their turn, better than A. As regards weed control there was no difference.

Supplying took place between the 4th and 11th September, 1950. The time taken per treatment, in man hours per acre, is shown in Table XXIV. Less supplying was required in the manured plots and possibly also less in the surface manured plots.

Table XXIV.

Time Taken per Treatment, in Man Hours per Acre.

(Experiment Kn. 39.)

A	....	....	....	149.90
B	....	....	....	111.60
C	....	....	....	95.84
D	....	....	....	97.40

On the 4th October, 1950, the plots were again marked for evenness of growth, colour and weed control, as shown in Table XXV. As regards evenness of growth and colour, the manured plots were better than the unmanured, and the surface manured plots better than the deep manured. For weed control the position was reversed, manure encouraging weed growth, especially when placed near the surface.

Table XXV.

Marks for Evenness, Colour and Weed Control.

(Experiment Kn. 39.)

Treatment			Evenness of growth.	Colour.	Weed control.
A	....	....	23	19	36
B	....	....	27	27	32
C	....	....	31	27	32
D	....	....	34	33	27

On the 7th November, 1950, the plots were again marked for evenness of growth, colour and weed control, as shown in Table XXVI. As regards evenness of growth, the manured plots were still better than the unmanured, and the surface manured better than the deep manured. It

is difficult to interpret the figures for colour and there was no difference in the weed control figures.

Table XXVI.

Marks for Evenness, Leaf Colour and Weed Control.

(Experiment Kn. 39.)

Treatment	Evenness of growth.	Colour.	Weed control.
A	24	29	32
B	32	27	32
C	36	23	32
D	39	28	32

The number of days to first flowering, 50 per cent. flowering, and ripeness are shown in Table XXVII. The manured plots flowered and ripened earlier than the unmanured.

Table XXVII.

Days to First Flowering, 50 per cent. Flowering, and Ripeness.

(Experiment Kn. 39.)

Treatment	First flowering.	50 per cent. flowering.	Ripe.
A	151	158	191
B	143	153	185
C	143	153	185
D	143	152	183

The data obtained at harvest are shown in Table XXVIII. Statistical analysis of the figures shows that placing all the manure on the surface of the soil causes the plants to be significantly taller than plants which received none or only part of their manure on the surface. Manure, wherever placed, caused a significant increase in height over unmanured plants. As regards the number of tillers per plant, manuring gives significantly more but there is no significant difference between methods of placement. The case of ear length is similar to that of plant height, manuring in any method significantly increasing it, and having all the manure on the surface of the soil giving significantly longer ears than any other method. There are no significant differences in the weight per gantang.

The yields are good and show that with deep ploughing and manuring yields of well over 200 gantangs per acre may be obtained with dry padi. Manuring has significantly increased the yield but there are no significant differences between the methods of manuring.

Table XXVIII.

Data Obtained at Harvest.

(Experiment Kn. 39.)

	A	B	C	D
Height of plants (ins.)	41.4	54.2	61.8	65.6
No. of tillers per plant	7.9	10.7	10.6	12.4
Tillers as per cent. of mean	(76.0)	(102.9)	(101.9)	(119.2)
Length of ear (ins.)	8.5	9.6	9.5	9.9
Length of ear as per cent. of mean	(90.7)	(102.4)	(101.3)	(105.6)
Treatment yield in lbs. per 4 plots of 1/10 acre	294.6	530.6	521.6	528.0
Treatment yield in lbs. per acre	736	1,326	1,304	1,320
Treatment yield as per cent. of mean	(62.8)	(113.2)	(111.3)	(112.7)
Weight per gantang (lbs.)	5.8	6.0	5.9	5.9
Yield, in gantangs per acre	127	221	221	224

Analysis of the Results.

The mass of data must be simplified in some way for a clear view of the findings to be obtained, and the results under individual factors are detailed below. This clarifies the position of the individual factors but interactions between factors and the degree of the response are underemphasised. The figures in brackets show the experiment from which the results were obtained.

Depth of Ploughing.

Average depths are:

Deep ploughing by tractors	....	8 to 9½ ins.
Shallow ploughing by tractors	....	5 to 6½ ins.
Cattle ploughing	....	5 to 5½ ins.

and consolidation of ½ to 1 in. takes place in the first month (Experiments Kn. 14, 15 and 38.)

Evenness of Growth.

Early ploughing reduces evenness of growth especially when deep (Kn. 14), but not when the plots are manured (Kn. 15 and 39). Surface manuring increases evenness of growth (Kn. 39), and tractor ploughing is better than cattle ploughing (Kn. 38).

Colour.

Early ploughing results in poor coloured seedlings, especially when deep (Kn. 14 and 15). Surface manuring improves the colour (Kn. 39).

Cost of Supplying.

Shallow ploughing decreases the cost of supplying (Kn. 38). Manuring decreases the cost of supplying (Kn. 39).

Weed Control.

Deep ploughing assists weed control (Kn. 38). Early ploughing assists in weed control (Kn. 14, 15 and 38). Manuring, especially surface manuring, increases weeds in the early stages (Kn. 39).

Tillering.

The number of tillers is increased by deep ploughing (Kn. 15) and manuring (Kn. 37 and 39). Tillering is depressed by early ploughing (Kn. 14 and 15), by chiselling in deep ploughed areas (Kn. 37) and by not weeding (Kn. 14).

Plant Height.

Plant height is increased by deep ploughing (Kn. 14 and 15), manuring (Kn. 14 and 15), early manuring (Kn. 38), while it is decreased by early ploughing (Kn. 14 and 15), by chiselling on deep ploughed areas (Kn. 37) and by weeding (Kn. 14).

Ear Length.

Ear length is increased by deep ploughing (Kn. 14, 15, 37 and 38), manuring (Kn. 39) and by surface rather than deep manuring (Kn. 39).

Yield.

Yield is increased by deep ploughing (Kn. 14, 15, 37 and 38), by manuring (Kn. 15, 37 and 39), especially when deep ploughed (Kn. 38), by weeding (Kn. 14) and by tractor ploughing deep or shallow rather than cattle ploughing, except when early manured (Kn. 14 and 38). Yield is decreased by early ploughing (Kn. 14 and 15) and chiselling deep ploughed areas (Kn. 37).

In brief it has been shown that the yield of dry padi in Kelantan can be increased by manuring, and by tractor ploughing, especially deep ploughing. There is evidence that this increase is caused by an increase in the number of tillers and in ear length and so in the number of grains per ear. Further investigations are required to ascertain the optimum time of manuring and to see if the size of grain is also affected.

The Possibility of These Results Being Practiced by Smallholders.

The area in which these methods of increasing the yield of dry padi are likely to be applicable covers the States of Kelantan and Trengganu.

In these two States the total acreage of dry padi is 45,000 acres and the average yield some 130 gantangs per acre, which gives a total crop of 9,200 tons of rice. It has been shown that yields of 220 to 250 gantangs per acre can be obtained and so the crop could be almost doubled from the same acreage. In both States there is also a considerable area of land known as *Tanah rang* on which, owing to low fertility and lack of manure and cattle, a padi crop is taken only once in four to seven years. With adequate tractors and artificial manures, these lands, the extent of which is not known, could be cultivated annually. It should therefore be possible to increase the rice production from dry padi by some 10,000 tons a year.

The smallholders in these States are conservative but, like all true peasants, extremely shrewd. They were not slow to realise the value of deep ploughing, and in the 1950-51 season 50 acres of smallholders land was cultivated by tractors belonging to the Department of Agriculture, the smallholders paying running costs which worked out at about $7 per acre. Likewise they realise the value of the artificial manure, and smallholders near the Experiment Station at Melor have asked for 1½ tons of the mixture used on the Station to be bought on their behalf. The Governments of the States concerned are also keenly interested, and, in Kelantan, the State Development Board has bought two Ferguson tractors with a loan from the Rural and Industrial Development Authority, for ploughing the smallholders land. In addition, arrangements are being made to demonstrate the value of the manures on smallholders dry padi land in both States.

There remains, however, the ugly fact that the dry padi planters are, for the most part, subsistence farmers, growing what they require and handling little, if any, cash each year. Some have rubber land and it is these people who are hiring the tractors and buying the manure. If these methods of increasing the yield of dry padi, and so improving the nutrition and living conditions of the smallholders, are to be used on a large scale, they may have to be subsidised, as indeed they are in most countries.

Summary.

The data obtained in six dry padi experiments during the 1950-51 season are reported and the results analysed. It has been shown that yields can be substantially increased by the use of tractors, especially when ploughing deeply, and by artificial manures. The possibility of these results being put into practice by the smallholders in Kelantan and Trengganu is discussed.

Acknowledgements.

The experiments were laid down by Mr. H. K. Ashby, State Agricultural Officer, Kelantan and Trengganu on the instructions of the Standing Committee on Investigations, Department of Agriculture. The writer wishes to acknowledge the efficient work of the staff of the Department who were engaged in the execution and recording of the experimental

work, and in particular to Che Hassan bin Haji Abdullah, Agricultural Subordinate, Special Grade, in charge of Melor Experiment Station, and to the workshop crew who maintained the tractors.

References.

1. ASHBY H. K. Dry Padi Mechanical Cultivation Experiments in Kelantan, Season 1948-49. *Malayan Agricultural Journal*, Vol. XXXII, July, 1949.

2. ASHBY H. K. (Articles not yet published).

MECHANIZATION

Quarterly Progress Report, July to September, 1951.

Compiled by the Senior Agricultural Officer (Research) and the Agricultural Officer (Engineering).

Recent Importations.

The following tractors and implements were received recently:—

Bristol '20' (Wide Gauge) tractor.
Rome Model TPS 8-24 disc-harrow.
Wild 5-gang seeder unit.

Tests and Modifications.

Rome Model T.P.S. 8-24.

This implement resembles the Ferguson Rough Duty 8-20 harrow which was described in this journal in 1950 (vol. 33, page 158), but which is now no longer in production. The Rome harrow is designed for direct attachment to the power-lift of a Ferguson tractor and can be obtained with 20, 22 or 24 inches diameter cut-away discs which are carried on large spindles fitted in cast iron bearings. The frame is massive and adjustments can readily be made to vary angle and direction of cut and the tilt of discs.

This harrow has been tested on both arable and waste land at the Federal Experiment Station, Serdang, where it was found capable of performing good work even on land bearing a heavy cover of *lalang* and Melastoma. The Ferguson tractor used was capable of pulling the harrow in second gear at a high working speed. The tall vegetation was crushed and cut up into short lengths and the soil was partially inverted so as to expose the grass roots.

Spraying Hoses for use with Aromatic Oil Herbicides.

It has been found that when normal spraying machines are used for spraying oil herbicides, the rubber hoses deteriorate very rapidly unless they are washed out, with a soapy solution, immediately after use. With the larger types of tractor-mounted sprayer this washing out is very laborious and a search has been made for suitable substitutes for natural rubber hoses.

Three hoses made of test materials were immersed in undiluted Sovacide PY for 15 days and were then washed and examined. The results were as follows:—

(a) The natural rubber hose was swollen and very soft. The rubber could easily be dug away from the canvas with the finger nails.

(b) The synthetic "oil resisting" rubber hose was also swollen and softened, although to a lesser extent than the natural rubber.

(c) The Alkathene hose (a polymerized ethylene plastic), although discoloured, showed no sign of swelling or softening.

Alkathene hoses have been in regular use on a tractor sprayer at the Federal Experiment Station, Serdang, for some time and although they are less flexible than rubber hose, and therefore not so easy to handle, they have proved very satisafactory in service.

Investigations into Wet Padi Cultivation.

An off-season cropping experiment at Pulau Gadong in Malacca was harvested in August. In every case shallow ploughing gave greater crop yields than deep cultivation.

After the off-season crops were harvested, the soil was extremely sticky and cultivation was difficult. The soil was therefore flooded to a depth of 4 to 5 ins. and cultivations were carried out with a Fordson Major tractor fitted with solid extension wheels with 6 ins. strakes. The ridges were levelled with a Martin disc-harrow, and the plots were then ploughed with a McCormick Deering 212 plough and prepared for transplanting with a disc-harrow and a Kedah roller.

The same combination of tractor and implements has been used elsewhere on Pulau Gadong Experiment Station. Most of the work has been carried out under water although, whenever possible, ploughing is done "in the dry." In some of the softer areas it has been necessary to use buffaloes for the final cultivations. A Caterpillar D4 tractor with standard tracks has been tried out with a disc-plough and heavy disc-harrows on the same area but the combination were not successful and the tractor finally bogged down and was completely submerged by flood water.

Investigations into Dry Land Crops.

Dry padi was planted in August in a "Depth of Ploughing and Off-season Cropping" experiment in Kelantan. Growth of padi has been good, especially on those plots which were cropped with groundnuts and cowpeas during the off-season. This is possibly due to the residual effects of the manures which were applied during the off-season, i.e. phosphate plus lime, although inorganic N.P.K. plus cattle manure received by the sweet potato crop appear to have had no residual effect.

In another experiment in Kelantan, cultivation of dry padi is being completely mechanized. The land was prepared with tractors in the usual way and the seed was drilled in July. Sticky soil conditions caused some irregularity in seeding but the crop is established and has been successfully weeded with the Ferguson Steerage Hoe. This weeding operation required approximately three man-hours per acre.

The Danuser Post Hole Digger, which has been described in previous issues of this journal (vol. 33, pages 98 and 226) has now been fitted to a Ferguson Tractor. It has recently been used to dig 1,350 planting holes for a banana experiment on inland soils in Negri Sembilan. The holes were about 24 ins. deep and 18 ins. in diameter; the cost per hole was approximately 3.3 cents.

NOTES ON CURRENT INVESTIGATIONS, JULY TO SEPTEMBER, 1951.

Compiled by the Acting Chief Research Officer and the Senior Agricultural Officer (Research).

Padi.

1. Research.

Variety Selection.

Programmes have been drawn up and issued in respect of field experimentations for the 1951-52 season for all States and Settlements except Selangor where planting is later.

Field experiments are well under way in Johore, Malacca and Negri Sembilan, and sowing and planting is now starting in the northern states.

Analyses of variety trials carried out over the past four years have been in progress during July to September, and a full report of this work is being prepared.

Growth in Nutrient Solutions.

To investigate and demonstrate the deficiency symptoms shown by padi when grown in nutrient solutions from which one or other of the trace elements had been left out, an experiment, using 600 c.c. pyrex beakers and Analar solutions, was set up. The beakers were covered with thick, brown paper, and a large cork with a small bore hole was used to support the padi plants, the cork being glued to the thick paper which covered the top of the beaker. Light was thus excluded from the solutions, and the padi seedling, surrounded by cotton wool, was suspended in the hole in the cork.

Twenty-six beakers were set up and contained a nutrient solution plus all the necessary trace elements, the intention being to give the seedlings a good start before depriving them of any one trace element. However, the plants did not grow well, turning pale and losing their turgidity, and most of them died. The solutions were not aerated as it was thought that the padi did not need such treatment. After this failure, the beakers were divided into four lots, fresh solutions were added and new seedlings planted. One lot was aerated twice daily with a small blowing bulb, the second lot was covered with the paper top and left; in the third lot, the top of the nutrient solution was covered with a thin film of oil while in the fourth lot the solution was left exposed to the air. In the first lot, i.e. that which was aerated twice daily, the plants grew very well, being dark green and healthy and much larger than the pale green and weak plants in the other three treatments. It would appear, from this experiment, that the leaves of padi plants cannot supply oxygen to the roots in the early stages of growth.

Pest Control.

Small scale tests with systemic poisons were continued with stem-borers. In no case was the result sufficiently promising to warrant further trials. This result was not altogether unexpected because the majority of these chemicals at present available appear to be effective primarily against sucking insects.

Disease Control.

The experiments on treating padi seed with various fungicidal dusts or solutions, mentioned in the report for the previous quarter, have been repeated, using seed which had been exposed to infection by *Helminthosporium oryzae*. In these tests, the seed was also planted in sterilised soil in pots. Suppression of germination, noticed in seed placed in petri dishes, in the case of Mergamma B, and Agrosan, did not occur. *H. oryzae* developed only on two seedlings—one in the Perenox pot and one in the control pot. In petri dishes *H. oryzae* developed as follows:—

Treatment.	Infection.
	per cent.
Merfusan 50% dust	90
Merfusan 30% dust	60
Formalin (2%) vapour	0 (poor growth)
Mercury chloride 1 : 1000	1 (excellent growth)
Control	40 (excellent growth)

A "mercury" dust and a solution, both called Tillex (a Sandoz product), are also being tested. Germination (in all dilutions) has been nil in petri dishes but seeds in soil germinated and grew satisfactorily following dusting. The solution, as supplied, needed to be diluted with five parts of water before germination in soil was successful. Phenylmercury "fixtan" (P.M.F.) is also being tested.

2. Agronomic Investigations.

Wet Padi.

In most States and Settlements the current season's agronomic trials with manurial and cultivation treatments are proceeding according to plan. Visual responses to fertilisers in young seedlings have been reported from Perak and Johore.

The leaf-eating larvae of the moth *Nymphula depunctalis* have been reported from Malacca where the padi crop in a phosphate manurial trial has sustained considerable damage.

At Kahang, in Johore, it is reported that no harvest can be expected from unmanured plots. Unfortunately, investigations in this area cannot be properly supervised owing to bandit activity.

In Kelantan, the experimental programme is very ambitious and, in addition to extensive investigations on the Department's Experiment

Stations, some three hundred simple trials with manurial treatments are being laid down on smallholders' land. These experiments are creating great interest and are said to be stimulating a demand for fertilisers.

Dry Padi.

Agronomic experiments are confined to Kelantan and Trengganu, where some extremely interesting and important investigations are in progress.

Marked responses from fertilisers are reported from Melor, where large differences are reported in a factorial manurial trial between plots receiving N.P.K. and those receiving any two of these nutrients. It is significant, however, that some degree of chlorosis is present in most of the manured plots, which may indicate that some other nutrients are required for healthy growth. This observation is supported strongly in a type of phosphate trial where the response from basic slag is comparable, vegetatively, with that from single or concentrated superphosphate but is superior in regard to freedom from chlorosis.

At one other Kelantan station, at Kampong Pusu, investigations with the application of trace elements in conjunction with N, P, K and Ca are in progress, and these may later throw some light on the deficiencies of Kelantan padi soils.

Cacao.

1. Research.

Trinitario Field Trials.

The first clonal trial at the Federal Experiment Station, Serdang, (Field 46B—FESS. 75) is now making good progress, but whilst the good plants are growing vigorously, the poor plants are still making very little progress.

The second clonal trial (Field 18D—FESS. 111) suffered from excess sun when the Adenanthera shade shed its leaves in July. Insect damage is still not under control despite frequent spraying. Both these clonal trials suggest that the cuttings were not large enough at the time of field planting. They should have been held in the Nursery for nine instead of three months.

The trial of Serdang-Cheras legitimate progenies (Field 9—FESS. 95) has suffered an exceptional number of casualties. Recent higher rainfall is improving conditions in the field.

The East Indies and West African clonal seedlings (Field 47-49) are both progressing satisfactorily. Differences in the vigour of the various East Indies progenies are marked.

Trinitario Selection.

Selection on Kinrara Estate continues. Six provisional selections have been made and self-pollinated to produce legitimate selfed progenies

Yield records are being maintained at Cheras and in the General Nursery at Serdang.

Amelonado.

Amelonado seed received from the Gold Coast was planted in germination beds at Pulau Tekong, off Singapore, on the 1st December, 1949. Seedlings were planted in Field 44 at Serdang in March, 1950. The first pod was harvested by the Director on 23rd July, 1951,—20 months after the seed was received in the country. Twenty-eight seedlings have been raised from this pod.

In comparative trials, Amelonado is decidedly more vigorous than unselected Trinitario but less vigorous than some progenies from selected Trinitario parents.

Criollo.

The illegitimate Criollo progeny trial, under oil palms, 10 years old (Field 43—FESS. 114), has not maintained its early promise. Growth has been slow and the seedlings are no longer healthy and vigorous. Root competition with the oil palms may be one factor concerned.

In the trial between Trinitario and Criollo in jungle rentices in Field 45B—FESS. 113, the plants are very healthy and making satisfactory growth. Criollo is proving less vigorous than Trinitario in this trial.

Vegetative Multiplication.

Results from the earlier buddings have given over 50 per cent. final successes in each case, but further buds are still developing. Summarised figures on the 29th August, 1951, are:—

Date of budding.	Nursery.			Baskets.		
	No. of buddings	Unions.	Growing	No. of buddings	Unions.	Growing
16th June, 1951	21	19	15	20	12	8
10th July, 1951	20	19	15	20	20	16
11th July, 1951	31	30	21	30	25	8
24th July, 1951	28	27	0	24	18	10
Total	100	95	51	94	75	42
Per cent. of buddings	—	95	51	—	80	45
Per cent. growing from successful unions	—	—	53	—	—	56

Further stocks were budded in the General Nursery with Amelonado buds. Further buds are still developing but results, as on the 30th August, 1951, are shown in the table on the opposite page.

Date.	No. of buddings.	Unions.	Growing.
14th June, 1951	179	173	102
26th June, 1951	66	64	34
13th July, 1951	16	15	10
Total	261	252	146
Per cent. of buddings	—	96	56

The first cuttings are being taken from the Amelonado budwood area. Every point in this area is now an Amelonado plant—buddings which originally failed having been replaced by basketed buddings.

Buds have been taken from the six provisional Kinrara selections and successfully budded on to stocks in the Serdang budwood area.

Vegetative Propagation—Cuttings.

A large wooden box, measuring 4 x 2.6 x 2 ft., with a lid of padded hessian and a bottom made of bamboo slats, was constructed. Six to nine inches of sand was placed in the bottom of the box. Cuttings were placed in the sand and placed in *full sunlight* in the continuous spray propagator. When the spray was stopped at night, the cuttings were covered with the moist, hessian lid which retained a high humidity round the cuttings at night. The cuttings were not examined until after 35 days had elapsed. Seventy-nine per cent. had rooted, which is not exceptionally high. The leaves of the cuttings were a very healthy, green colour with no suggestion of yellowing, even after 35 days in full sunlight and continuous spray. Of 95 cuttings taken, 40 had 20 to 40 roots, 10 had 10 to 19 roots and 25 had less than 10 roots each. Rooting was far superior to the average obtained in sand beds.

The single trial has not yet been repeated but appears to refute the idea that shade is required to root healthy cacao cuttings. Further investigations are in progress.

Various rooting media have been tried as an alternative to river sand. Sawdust appears promising. In one small comparative trial, cuttings rooted in sawdust gave an average of 6.75 roots with a maximum length of 3.2 cms., and cuttings rooted in a sand bed gave 3.2 roots with a length of 2.3 cms., both after 21 days. Sawdust is now being tried on a larger scale.

In order to avoid the use of hardening bins (which are still used for cuttings rooted in the continuous spray propagator) the following was tried;—

50 cuttings were placed in a box, as mentioned above, using sawdust as the rooting medium. After 28 days, the spray was reduced each day until, after a further nine days, the cuttings were only being sprayed for one hour per day. The surviving 28 cuttings were then placed in the usual planting baskets; 23 cuttings are now well established in baskets, five having died. Thus a final 46 per cent. success has been obtained.

With modifications, the technique may enable boxes of hardened cuttings to be distributed. These would be easier to transport than basketed cuttings and enable one lorry to carry several thousand instead of 300 basketed cuttings.

Isolation Nursery, Pulau Tekong.

In June, 342 plants of New Guinea material were released from quarantine. There are now only a few plants at the Nursery; these showed symptoms of an iron or zinc deficiency and are under treatment.

Pod Rot.

Pods were received for examination by the Senior Plant Pathologist at intervals during the quarter. *Diplodia* was the fungus commonly present in these specimens, but in a few instances Anthracnose was found. In one pod, heavily affected by Helopeltis, *Fusarium* sp. and *Nectria* sp. are present.

2. Agronomic Investigations.

Work has commenced on the opening up of the Federal Experiment Station, Jerangau, in Trengganu. Jungle on a building and nursery site has been felled and partially burnt, and 2,500 Trinitario cacao seeds have been sown in germination beds. About half this number have been transferred into baskets. The establishment of a nursery of Amelonado cacao is in progress.

At the Federal Experiment Station, Serdang, a prolonged spell of hot, dry weather during the quarter had a marked effect on some cacao trials but not on others. An important multiplication block of Amelonado cacao received a severe set-back associated with sun scorch of exposed stems. This field has a history of insufficint secondary shade, as Manila hemp was planted for this purpose but it did not thrive. Replacement shades of a number of species are only just beginning to give reasonable protection.

In adjacent fields, where cacao has been planted under jungle shade or under a good mixed stand of *Gliricidia sepium* and *Erythrina subumbrans*, growth has been satisfactory, with no appreciable dry-weather check.

Oil Palm.

1. Research.

Selection and Breeding.

The "dumpy" palms in Field 3A at Serdang gave an exceptionally

heavy crop in the period January to June, 1951, giving the highest yield of any of the pedigree progenies in Fields 3A and 4.

The majority of the legitimate "dumpy" seedlings, germinated earlier this year, are now established in six nurseries—one at Serdang and five on estates. One estate nursery has suffered heavy casualties (27 per cent.) due to rat damage, leaf-eating insects and an exceptionally dry spell. The other nurseries are progressing satisfactorily.

Two fertile pisifera palms have been located in Field 19—Palms Nos. 29 36 and 36|21. The fruit of these palms is full size, there is no shell and the kernel, which is the size of a pea, often contains a viable embryo. Pollen from these palms has been collected and will be used for breeding purposes.

A sixth series of leaf samples from oil palms of the families E97, E207 and E268 at Serdang has been analysed by officers of the Chemistry Division. The palms had been manured on the 15th April, 1951, with N.P.K. and magnesium and there was a slight indication in the latest analysis that the Mg content of the leaves had increased.

Uptake of Aluminium.

A survey of the aluminium content of oil palm leaves has been carried out by the Acting Senior Chemist on leaves from the Federal Experiment Station, Serdang. Each sample for analysis consisted of a composite sample of pinnae from 10 to 15 palms. The pinnae were collected from the most recent, fully opened frond. In some of the larger fields, two composite samples were obtained and, in the case of Field 4, samples which had been obtained from the various selections for another purpose were used.

Two oil palm seedlings which had been grown in hydroponics solution containing up to 20.6 gm. per litre of aluminium sulphate were also analysed for Al_2O_3. The highest recorded Al_2O_3 content in the ash of the leaves was 3.86 per cent. and the lowest 1.19 per cent. The percentage in the leaves of the hydroponic palms was fairly high but not as high as some of the field samples. The roots of the hydroponic palms were also analysed for Al_2O_3 content and found to contain much larger amounts than the leaves.

Another hydroponics experiment, to test the effect of low CaO and high K_2O and of low K_2O and high CaO, started on the 1st March, 1951, has been terminated and the plants taken out for analysis. On the whole, the appearance of the plants in all the treatments was very similar.

Pest Control.

Reports of pests serious enough for visits to be called for were:—*Apogonia cribricollis* Burm. on leaves of seedlings near Kuala Selangor, and a Psychid related to *Brachycyttarus subtalbatus* Hamps. on mature fronds near Klang, Selangor.

A visit to an estate in Batu Laut, Selangor, showed that damage to coconuts by *Oryctes rhinoceros* was, by comparison with oil palms, so

much more severe that the final effect in oil palms could be regarded as negligible once they had been in the field for 2½ years—a total of 4 years from germination in the nursery.

2. Agronomic Investigations.

Yield results have been received from an important factorial manurial experiment on a Selangor estate. The treatments involve application of rock phosphate, muriate of potash, magnesium sulphate and a combination of these fertilisers. Analysis of the first six months' results failed to reveal significant differences. Fertilisers for a second application have been supplied to the estate but have not yet been applied owing to banditry in the area. It is feared that the recording of yields will also suffer for the same reason.

In an intercultivation experiment at the Federal Experiment Station, Serdang, the analysis of variance of yields for the three years 1948 to 1950 inclusive, failed to reveal significant differences. This trial will continue for another three years.

Coconut.

1. Research.

Two visits were paid to Singapore by the Acting Senior Entomologist to assess the damage by the Philippine leaf-mining beetle *Promecotheca cumingi*. At the end of June, the range had extended in the Kallang area up to McPherson Road, in Paya Lebar to Jalan Eunos and in Siglap to Telok Kurau Road. At the second visit there was a slight 'bulge' at the Serangoon-McPherson Roads junction but a fading off in the east, and it appears as if the attack has now been held by parasites. Four parasites have been bred in Kuala Lumpur (two egg and three larval, but one of these may be a hyperparasite). All were new records for Malaya but recorded in Java from a closely related beetle. Host plants, additional to coconut, found in June were areca, royal and oil palms but none of these were attacked severely. The most heavily damaged area continues to be coconut palms growing in Sims Avenue and Aljunied Road, Geylang.

2. Agronomic Investigations.

A factorial manurial trial on poor inland soil was laid out at the Federal Experiment Station, Serdang, and planting holes and drains were dug.

In a drainage and cultivation trial at the Federal Experiment Station, Port Swettenham, comparative yields for the year July, 1950, to June, 1951, were as follows:—

Main Treatments.

A.	Ditched, ploughed and harrowed -	970	nuts per acre.
B.	Ploughed - - - -	1,035	„ „ „
C.	Control - - - -	1,238	„ „ „

Sub-treatments.

1.	Harrowed - - -	1,220 nuts per acre.
2.	Grazed - - - -	920 „ „ „
3.	Cover Mown - - -	1,103 „ „ „

Differences did not approach significance at the 5 per cent. point but the main treatment differences were significant at about 15 per cent. Replications in this experiment are inadequate.

Fibre.

1. Research.

Manila Hemp.

Three seedlings, raised in sterilised soil in pots in the insect proof cages at Kuala Lumpur, were colonised with aphids (*Pentalonia nigronervosa*) taken from a healthy banana plant. One extra plant was not colonised. In a similar cage, three similar seedlings were colonised with similar aphids which had been fed on Manila hemp plants, in the varietal block and parent nursery at the Federal Experiment Station, Serdang, representative of those which Dr. Magee considered to be infected with bunchy top. In this cage also an extra seedling was not colonised. All plants have grown well, and, one month after the aphids had been placed on them, were sprayed with Accotox in order to kill the aphids which had bred and become very numerous. No virus symptoms have developed to-date.

Specimens of leaves of Abaca and a wild *Musa* sp. received from estates were affected by *Gloeosporium musarum* leaf spot, and by a *Rhizoctonia* sp.

2. Agronomic Investigations.

A Mauritius hemp shade experiment which was due to have been planted at Federal Experiment Station, Serdang, has been postponed until 1952, owing to labour shortage and the priority given to cacao and tea investigations.

A factorial ramie manurial trial has been planted on peat soil near the Selangor coast. Early growth has indicated that nitrogen is a limiting factor and that inorganic phosphate and potash, unbalanced by nitrogen, encourages premature flowering. A peat burn gives more healthy early growth than a dressing of 15 tons per acre of ground limestone applied 19 days before planting.

In two jute spacing trials in Pahang and Selangor, growth was only moderate on a clay loam but quite good on a coastal muck. In Pahang, yields from plots sown broadcast or in drills 1 ft. apart were significantly superior to yields from plots drilled at 2 ft. spacing.

The same trend was noticed on the Selangor muck but differences were insignificant. However, the percentage of fibre in the latter State was significantly higher (at the 5 per cent. point) from the broadcast crop than from drilled ones. Jute crops in Perak, Malacca and Kelantan have been disappointing, with light crops of short stems which flowered prematurely.

Tea.

1. Research.

Selection.

Study of characters of 264 field-selected bushes at Cameron Highlands was continued, and preparations have been made for putting down clonal rooting trials in October or November.

Blister Blight.

Since June, the disease has not been recorded on lowland estates which have been sending in records of incidence.

The records taken on an estate at Cameron Highlands have given interesting results. Recording was discontinued during the quarter and future records will be obtained at the Agricultural Station, Tanah Rata, where experiments are being conducted. An article on Blister Blight disease at Cameron Highlands, giving the results of the first year's experiments and observations, was prepared for publication. The influence of climatic conditions on the incidence of Blister Blight has been demonstrated, and it has been shown that excellent protection is afforded, to bushes recovering from pruning, by spraying with a copper fungicide. It appears that pruning can be undertaken without serious risk at most periods of the year, except perhaps between September to November, provided spraying is undertaken should wet weather set in.

The sampling of tea leaves for copper treated and control bushes at the Federal Experiment Station, Serdang, has been continued. The copper content of the leaves from Experiment No. 2 has been consistently higher than that in Experiment No. 1. Thirty samples of tea leaves have been received from Cameron Highlands during the period under review. These samples had been taken from sprayed and unsprayed areas in experiments on the control of Blister Blight. The copper content of some of the samples from the sprayed area reached as much as 200 parts per million Cu on the moisture free sample as compared with 18 to 20 parts per million in the control.

2. Agronomic Investigations.

In two trials to compare the ease of establishment of rooted cuttings and seedlings the following casualties have been recorded during the period January to June, 1951:—

Seedlings	....	....	7.8 per cent.
Cuttings	....	....	28.8 „ „

In a manurial experiment, where three different levels of nitrogen are being tested, casualties during the period November, 1947, to June, 1951, have totalled 384 bushes or 10.3 per cent.

Selected mother bushes at Federal Experiment Station, Serdang, have been pruned, weeded and manured. Rooting trials are continuing.

Coffee.

1. Agronomic Investigations.

In a shade and variety trial at the Federal Experiment Station, Serdang, Uganda coffee has outyielded Liberica coffee during the first

cropping year, the difference being significant at the 5 per cent. point. There was some indication that shade was detrimental to Liberica but not to Uganda, but yield differences were not significant. No interim conclusions are justified because the beneficial effects of shade are likely to be long-term ones.

Fodders.

1. Research.

Analysis of samples of Guinea grass from the sulphate of ammonia experiment at the Federal Experiment Station, Serdang, has been continued. The results follow the same trend as was noted in previous analyses, the protein content of the plots treated at rates of 6, 8 and 10 cwts. per acre sulphate of ammonia giving approximately the same increase in protein content. The CaO content is fairly constant for all the samples.

Samples have also been taken from the Napier grass plots which are receiving sulphate of ammonia at 10, 15 and 20 cwts. per acre. Five varieties of Napier grass are included in the experiment. In most cases the samples show a substantial increase in protein content with the heavier N dressings, the highest recorded being 17.06 per cent. protein on a moisture-free basis.

2. Agronomic Investigations.

There is still no response to phosphate in Guinea grass manurial trials at the Federal Experiment Station, Serdang. On this type of soil, potash is at least as important a nutrient as nitrogen and, in two trials, it has been shown that heavy applications of the latter nutrient aggravate potash deficiency.

All fodder grass experiments are now maintained by mechanical inter-row cultivation, using either a Ferguson or a Ransomes M.G.5 tractor with row-crop equipment. This has been found to be very successful indeed.

Stylosanthes gracilis has seeded in dry weather in the northern States of Kedah and Kelantan only. At Melor, in the latter State, the following yield of green fodder was cut from a block of this fodder:—

Month		Yield per Acre.	Rainfall in inches.
June	....	7,377 lbs.	3.43
July	....	11,170 lbs.	7.13
August	....	4,712 lbs.	4.39

This yield is said to be superior to that which can be obtained from fodder grasses on similar soil in Kelantan.

Two recent importations which promise to be of considerable value are *Indigofera teysmannii* and *I. doshua*. The former is growing well in Selangor and the latter, which was imported from Indonesia, is under trial at Cameron Highlands.

Pastures.

1. Agronomic Investigations.

A large factorial manurial trial on pasture grass at the Federal Experiment Station, Serdang, has been designed after recording pre-treatment yields for seven months. The design is a balanced 3 x 3 x 3 layout with four replications giving 108 plots. The sward consists mostly of *Axonopus spp.* and it is shaded by young rain trees, *Enterolobium saman,* planted 40 x 40 ft.

Further trials with an aromatic oil herbicide have shown that it cannot be used to control *Mimosa pudica* since a lethal dose also kills grass. However, a proprietary herbicide containing 2,4-D and 2,4,5-T has shown very great promise indeed. A one per cent. solution with added detergent killed all the Mimosa without seriously affecting the grass, and two months later there was no sign of regeneration.

Pineapple.

1. Research.

All fruit from a hormone trial and a 5 per cent. sample from a fertiliser trial are in course of analysis and trial by canning at the Canning Research Station, Johore Bahru. At the end of the period under review, 31 fruits had been canned and a total of 417 physical and chemical examinations carried out on them. This work is still in progress.

Earlier in the period, work was done, as far as time and staff permitted, in the examination of the pineapple crop as received at the canneries. The first results indicated that the work must take early priority in all future crop programmes, when more thorough samplings must be carried out. It is hoped to publish results of this work in an Information Paper in the future.

During a visit by the Acting Senior Chemist (Soils) to the Pontian area of Johore, opportunity was taken to inspect the wilted areas and also the area where an N.P.K. experiment is being carried out. Both Chuan Seng and South Malayan Plantations were visited and leaf samples taken from areas showing wilt and those which appeared to be free from wilt. A single leaf was taken from a non-fruiting plant, the 10th leaf from the inside of the spiral being selected, and the leaves from several plants were taken to make one sample. The leaf samples were analysed for N, K_2O, P_2O_5, CaO, Fe_2O_3, Cu and Mn. The amounts varied from sample to sample, but for CaO the healthy plants appeared to be consistently higher. One sample from a good area was extremely high in Mn. It contained 0.4 per cent., a value about 10 times as high as the other plants.

However, only six samples were examined, so no conclusion can be drawn, but it is intended to analyse further samples. Leaf samples were taken in a similar manner from the 5 x 5 Latin Square N.P.K. experiment on South Malayan Plantations. Although the results have not been examined statistically, it appears that the K and N.P.K. treated

plots are significantly higher in potash. The N or P_2O_5 content of the leaves is not increased by treatment with these elements.

Experiments with proprietary brands of Parathion were continued against the mealy bug causing wilt (*Pseudococcus brevipes* Ckll.). Preliminary observations show that the dust is more promising than the liquid and this in turn is more toxic than the wettable powder. A thorough count of the number of mealy bugs present involves stripping of the leaves owing to the insects congregating in the axils.

Tests are being made by a local firm in Johore using two other systemics and T.E.P.P. but no conclusive results have been obtained.

2. Agronomic Investigations.

Harvest of the plant crop of a manurial trial on muck soil on the Selangor coast was completed in July. The annual fertiliser dressings were:—

A. Organic N.P.K. at 4 cwt. per acre.
B. Organic N.P.K. at 4 cwt. per acre plus 5 cwts. per acre inorganic N.P.K.
C. Magnesium limestone at 5 cwts. per acre.
D. Magnesium limestone at 5 cwts. per acre plus 5 cwts. per acre inorganic N.P.K.
E. 5 cwts. per acre inorganic N.P.K.
F. Control, no fertiliser.

There were no significant differences between the weights of fruit from different treatments but the three treatments which included inorganic fertiliser gave a significant increase in fruit size.

Investigations will continue on the first two ratoon crops and observations will also be made on the growth rate of the interplanted rubber. An extensive series of manurial trials have been planned for the peat areas of south Johore, and the new Federal Experiment Station at Alor Bukit, near Pontian, is now in process of being opened. This station will be used for pineapple investigations.

Vegetables and Foodcrops.

1. Research.

Soyabeans.

Selection work on recent Java introductions is still in progress, while variety trials of earlier selections are also being continued.

Sweet Potatoes.

Sorting of the collection at the Federal Experiment Station, Serdang, continues. The collection has been rearranged and replanted. It is proposed to take preliminary yield data of 'tops' from the current crop.

Brinjals.

Brinjal plants at the Experiment Plantation, Kuala Lumpur, were killed by slime disease. It is proposed to use the site for a test of Chloro-

bromo-propene (Shell Co.) and D.D. soil fumigants as a control of slime disease (on tomatoes).

Vegetables at Cameron Highlands.

Carrots.

The Plant Pathologist reports that carrot (var. Manchester Table) at Tanah Rata was badly attacked by *Alternaria dauci*, whereas two varieties imported from Japan showed resistance.

Tomatoes.

Tomato (var. Burpees' Matchless) was badly attacked by Blight (*P. infestans*) at Tanah Rata.

French Beans.

Experiments were carried out on use of Perenox and Bordeaux mixture in spraying French beans against Anthracnose, celery against *Septoria* leaf spot, and carrots against *Alternaria dauci*. Results to date have been satisfactory, and experiments are being continued.

2. Agronomic Investigations.

In the Experimental Plantation, Kuala Lumpur, variety trials on the following crops have been harvested during the quarter: dwarf French beans, climbing French beans and sweet corn. Investigations on French beans will continue next dry season. The sweet corn trial indicated that open-crossed Stowells Evergreen yielded as well as three hybrids and better than three other hybrids. Since the quality of this variety was good, no further investigations are contemplated.

Seed-crops of "Choy Sam", Chinese mustard, and of long beans have been harvested. Mass selection will continue.

Observations and experiments on the off-season cropping of padi land in Perak have indicated that groundnuts, sweet potatoes and long beans will all crop well under favourable conditions and that selected soya beans are also promising.

A number of variety and manurial trials have been harvested at Cameron Highlands and results are now being analysed.

In a beetroot manurial trial, the chlorides of potassium and sodium gave significantly higher yields of roots than equivalent dressings of sulphates. The two elements concerned appeared to be of equal manurial value. This result suggests that the known response of beet to common salt is due to the chlorine and not to the sodium in the salt.

Variety investigations on Irish potatoes at Cameron Highlands are continuing with Dutch seed. In Trial C.H.13/51, the mean yield was 14,706 lbs. per acre, with Voran, the highest yielder, giving the equivalent of 20,873 lbs. per acre. Other high-yielding varieties were Profijt, Sientje and Zeeburger. The variety Furore was the most resistant to Phytophthora wilt but proved susceptible to a bacterial soft rot. A second trial on comparatively infertile, shallow soil gave somewhat different results but Voran was again the best yielder of thirteen varieties under trial. These investigations will be continued in 1952.

A variety trial of six local varieties of tapioca with harvesting at 10, 12 and 14 months was completed at Bukit Mertajam during the quarter but the results have not yet been analysed.

Tetracarpidium Conophorum—Conophor Nut.

A consignment of 257 seeds of this liane was received by air from Nigeria in July, and 80 per cent. have germinated to-date. This plant is being tested in as many different ecological zones as possible, using different host trees as supports.

Plants raised from seed sown in August, 1950, are now in flower but no seed has been set.

Chinese Gooseberry.

Seed of *Actinidia chinensis* has been imported from New Zealand and observations on this fruit will be made at Cameron Highlands.

Livestock.

Goats.

The Serdang flock of pure-bred goats continues to give a good milk yield and liveweight gains are satisfactory.

The following kids have been born during the quarter:—

Saanen pure-bred	....	....	3 females.
Saanen quarter-bred	....	....	1 male, 1 female.
Toggenberg pure-bred	....	....	1 male, 1 female.
Toggenberg half-bred	....	....	2 females.
Local	....	....	1 female.

Unfortunately the three Saanen kids died of pneumonia after four days.

Total milk yield during the quarter was 4,272 lbs. British Alpine Doe No. 4, which has been in milk for 92 days, averaged 7.46 lbs. per day.

All imported goats in the herd were attacked by "Kuru", a bacterial infection causing mouth and nose sores. On the advice of the Veterinary Department, these goats were treated with Sulphanilamide mixed into a paste with coconut oil. This treatment proved effective and all animals have recovered. One attack is said to confer future immunity.

Blood tests made by the Veterinary Department have shown that eight goats are infected with *Brucella abortus*, which organism causes Brucellosis or contagious abortion in cattle and undulant fever in man. Goats act only as carriers and are not affected in any way by the disease. The infected animals have all been isolated and the less valuable will be destroyed.

Cattle.

Blood tests made by the Veterinary Department have shown that a number of animals are infected with *Brucella abortus*. Those animals which are likely to be a future source of infection will be destroyed.

Poultry.

Most of the feeding and management trials are proceeding satisfactorily but, on one Agricultural Station, intestinal worm infestation has been high. Birds are in lay and, in at least some of the trials, Rhode Island Reds are much superior to kampong birds in egg production when fed on Serdang rations. Results from kampong rations are more variable.

Small feeding trials in Perak have given inconclusive results with *Leucaena glauca* due to lack of replication. These and other trials are continuing and results will be watched with interest.

Pigs.

A test feeding of locally produced palm kernel cake to local sows has indicated that this feeding stuff can be substituted for copra cake without any trouble.

Weed Killers.

A number of trials on emulsifying the weed killers Sovacide PY and PYD have been carried out. Various emulsifiers, such as Teepol, Lissapol N, Lubrol and soap solution, were tried. Emulsification was performed by using either a high speed stirrer or a "cream maker." The minimum amount of emulsifier, the minimum times of stirring and the minimum amount of water required to give a stable emulsion were all investigated. When these factors were optimum it was quite easy to make an emulsion. It was also found that by shaking on a reciprocating shaker for 5 minutes, a very stable emulsion could be made for PY + Lissapol N + water in the proportions of 100 : 4 : 90; this could be diluted. Sovacide PYD was found to be more difficult to emulsify than PY.

Peat Soils.

It has been noted that when peat in pots has been treated with lime, the material turns black and assumes an appearance similar to leaf mould. Some of this decayed peat has been fractionated and it has been found that the amount of the chloroform and alcohol-soluble fractions has decreased.

In experiments with large pots of peat, liming and addition of N.P.K. and copper sulphate have been tried on soya beans, maize and tomatoes. Maize and soya beans grew well on the limed pots, the best results appearing in the N.P.K. plus lime at 10 tons per acre and copper sulphate at 50 lbs. per acre. In some of the pots, poor growth of soya beans was obtained and it was suspected that this was due to the absence of the appropriate micro-organisms. In the unlimed pots, the plants grew a few inches and then died off. The maize suffered from insect attack and no crop was harvested. The tomatoes also suffered badly from wilt. Ramie was planted in similar pots of peat, and liming was one of the treatments. Also included was burning, both *in situ* in the pot and also burning a similar quantity of peat outside and adding the ash;

growth was best when lime and N.P.K. were added. Lime alone also gave a fair growth, as did the pots where the peat was burnt in the pots. Where the ash was added, growth was not nearly so good. This would indicate that burning in itself was beneficial apart from adding ash to the peat.

The addition of lime to peat in pots in which padi is growing has also been tried but so far the indications are that the lime, if anything, exerts a detrimental effect on the padi.

Miscellaneous Analyses.

A sample of the overburden dust from the Christmas Island phosphate deposits was analysed for P_2O_5, Al_2O_3, Fe_2O_3 and Cao. The sample contained over 30 per cent. P_2O_5 but the content of Al_2O_3 and Fe_2O_3 was also high, being over 20 per cent.

NOTES ON EXTENSION WORK, JULY TO SEPTEMBER, 1951

Compiled by the Acting Chief Field Officer.

Padi.

Selected Seed.

A total of 8,363 gantangs of padi seed was distributed during the quarter.

Improvement to Padi Areas.

There are many minor works and improvements to padi areas that are carried out by the people themselves for a nominal reward. Such works are frequently initiated by officers of the Field Branch of the Department. For this purpose special funds are made available by some State Governments. During the last quarter in Perlis, 2,100 acres have been improved by various works carried out by the people themselves, at a total cost of only $1,675.

Mechanical Cultivation.

The May to September dry season saw the first real advances in extending mechanical cultivation on a commercial basis to smallholders. During the previous quarter, the two Rural and Industrial Development Authority schemes in Selangor and Kelantan had only just commenced and this last quarter has given some indications of how the schemes may develop. Kelantan had the advantage of knowing, from earlier experiments, that deeper cultivation increased yields on their old dry padi lands. In Selangor, the area of operation is a new padi area, yields are high under traditional methods, and since the people were more prosperous they were eager to hire the tractors to save labour in preliminary cultivation, but also to obtain off-season crops on the padi fields. The soil conditions and the climate of Kuala Selangor are more favourable to this intensive double cropping than Kelantan. In Selangor, two tractors performed a total of 876 hours of paid work in the four months from May to August.

In other States and Settlements, notably Perak and Province Wellesley, extension work in the hire of tractors is being done with Departmental equipment, but this is necessarily limited to periods when the tractors can be spared. This work is preparing the way for RIDA schemes. Some private individuals or groups have recently entered the business, and this should be a welcome development. The only comment at present on these enterprises is that their charges are extremely high, equivalent to five or six times as much as is considered economic for the R.I.D.A. schemes. It should be of interest to compare the approximate costs of mechanical ploughing and hand cultivation on rough land. Hand cultivation will cost up to $250 per acre. Conservative costings of a properly managed and fully worked tractor will give a figure of $25 to $35 per acre. This vast difference explains why really excessive

charges will seem reasonable to progressive smallholders who are anxious to expand their farming.

Manuring.

Manurial experiments have given significant results on padi in Kelantan. This season, 300 trials on smallholders' land have been planned. These are causing very great interest and they should serve the purpose of giving the smallholders an object lesson in manuring and the idea of differentiating between the different sorts of manures, i.e. nitrogen, phosphate and potash.

Rubber.

During the quarter 12,704 yards of budwood, 49,215 clonal seedling stumps and 26,849 germinated clonal seeds were sold and distributed to smallholders under Colonial Development and Welfare Scheme No. D. 1176. The sale of budwood (4,138 yards) shows a big increase over the previous quarter. The sale of seedling stumps and germinated seeds (218,580 and 198,265 respectively last quarter) shows a decrease. This is entirely a matter of planting seasons, which are approximately September to November and February to March, and the main seedfall is usually in late August, September or October.

Processing and Marketing.

The various schemes for the bulk purchase of latex continue to operate, but the future is not so certain as it appeared a short time ago. There has been a slight change in market requirements. The overseas demand for latex in bulk is declining in favour of sheet rubber. To meet this changing situation, plans are already being made in some States to organise central collecting stations and factories for the making of sheet rubber.

Coconuts.

In the Kuala Selangor District of Selangor, a cattle and coconut demonstration has been laid down in co-operation with a local farmer. The holding has been drained and fenced with Departmental assistance and advice, and the owner has purchased cattle. It is anticipated that the drainage and grazing will create an improved pasture under the coconuts and serve as a demonstration in an area where this type of mixed farming is not practised. Also in the Kuala Selangor District, there has been a most satisfactory response to advice and encouragement to erect the Department's improved copra kiln. Over 50 of these new kilns can now be seen in the coconut belt.

Fruit.

The opening up of resettlement areas will create an increased demand for budded fruit trees, and most States are planning to expand their fruit work. During the quarter, 2,601 budded fruit trees were sold.

Cacao.

All States and Settlements have been requested to open isolation seed gardens, up to 10 acres in each State or Settlement. These will be

planted with high quality planting material and serve both as demonstrations and a source of seed.

Livestock.

Pigs.

During the quarter, 51 Middle White boars and gilts were sold. In many areas the Chinese farmers hold the view that the half-bred sow is very much superior to either the local or the pure-bred sow. There is an increasing demand for young boars for sale and for the services of the Department's stud boars.

Poultry.

The distribution of Rhode Island Red birds and eggs was as follows:—

Cockerels, pullets, chicks	162
Eggs for setting	2,585

Pests and Diseases.

The Department takes an active part in the destruction of pests such as wild pig, squirrels, monkeys, rats and bandicoots. Kedah, for example, during the last quarter, reports the following successes of known kills:—

Wild pig	526
Squirrels	4,224
Monkeys	632
Various pests	491
Rats	13,106
Bandicoots	2,625

General Notes

FOOD AND AGRICULTURAL ORGANIZATION REGIONAL CONFERENCE

"Land including its water supply, on which crops, farm animals and forests are produced is the most important resource for the support of mankind. Unfortunately, however, the misuse and underdevelopment of this resource is widespread, often giving rise to hardships and loss, and limiting the level of living of the people. Such conditions prevail in many parts of Asia and the Far East."

The above quotation is taken from the preamble to the recommendations for a land improvement programme made by the Regional Conference on Land Utilization in Tropical Areas of Asia and the Far East. This Conference, which was organized by the Food and Agricultural Organization of the United Nations, was held in September, 1951, at Nuwara Eliya in Ceylon. Fourteen countries were represented at the Conference as well as members of the F.A.O. Secretariat and representatives of E.C.A.F.E. and the Holy See.

The United Kingdom delegation was led by Sir Geoffrey Clay, K.C.M.G., O.B.E., M.C., Agricultural Adviser to the Secretary of State for the Colonies. In this Delegation were four members from the Federation of Malaya and one from North Borneo. They were the Member for Lands, Mines and Communications, Dato Mahmud bin Mat, C.M.G., O.B.E., the Director, Drainage and Irrigation Department, Mr. P. McNee, the Senior Agricultural Officer (Research) of this Department, Mr. E. F. Allen, Mr. J. Wyatt-Smith of the Forest Research Institute, Kepong, and Mr. H. G. Keith, Conservator of Forests, North Borneo.

In considering how the land and water resources of this region could best be improved the Conference discussed a wide range of subjects under the following main headings:—

(a) How to determine the best use of tropical land and water resources.

(b) Once the most economic use of land and water resources has been decided upon, how to prevent undesirable uses and bring about the approved uses of these resources.

(c) How to preserve and improve the productivity of tropical land and water resources during use, assuming that an approved use has been achieved.

Facilities were provided for delegates to visit a number of Agricultural Stations, Government Farms and Colonization and Irrigation Schemes, most of which were located in the monsoonal zone in the north and north-east of Ceylon. These visits enabled delegates to appreciate the vigorous and enlightened steps being taken by the Government of Ceylon to solve their particular problems of land utilization.

It is felt that the Conference was of considerable value, not only because of the benefit obtained from the formal discussions but also because of the interchange of information and ideas between delegates from different countries. When the Conference ended delegates returned to their own countries with a feeling of gratitude to the government and people of Ceylon for acting as hosts and arranging meetings in such beautiful surroundings.

E.F.A.

Departmental Notes

The Retirement of Dr. T. A. Buckley, M.Sc., Ph.D., F.R.I.C,

Another gap in the already depleted senior staff of the Department of Agriculture occurred with the departure of Dr. T. A. Buckley on the 24th October, 1951, on leave prior to retirement.

Dr. Buckley was appointed Assistant Chemist for Forest Research on the 27th January, 1928, and arrived in Malaya on the 23rd February, 1928. While with the Forest Department, Dr. Buckley investigated the various damars of the Malay Peninsula and published an interesting paper on his work. He also investigated tannin contents of mangrove barks.

As the Forest Department had no adequate chemical laboratories, he worked in those of the Department of Agriculture from the start, and eventually, on the 1st January, 1932, was formally absorbed into the Agricultural Department staff.

The title of Assistant Chemist was changed to Chemist on the 1st July, 1937, and on the 1st January, 1939, on the appointment of Major Georgi as Chief Research Officer, Dr. Buckley was in turn appointed Senior Chemist in charge of the Chemistry Division.

He was a member of the Local Defence Corps in Malaya in 1940-41, and in February, 1942, was interned in Singapore till the end of the war in the Pacific.

He returned to Malaya, after leave, on the 20th June, 1946, and was Acting Chief Research Officer until the 19th October, 1946, an acting appointment which he filled again from the 19th October, 1948, until the date of his departure.

After joining the Department of Agriculture in 1932, Dr. Buckley's chief interest was in palm oil, as regards factory processing, and the nutritional or carotene values. He also worked on rotenone and other toxic contents of derris in conjunction with Major Georgi; on extractions of Cinchona bark in co-operation with Dr. Field of the Institute for Medical Research; and on the chemical aspects of manufacture of tea.

He continued his interest in tea processing after the war, and contributed considerably also to the study of soil-water relationships in padi areas. He took a particular interest in the causes of acid toxicity in *gelam* coastal soils.

Dr. Buckley was of a shy, taciturn temperament, but a man of logic, hard facts and great concentration and persistence. He was one of the ablest chemists this Department has had, and his wide knowledge in his field and his clarity of mind will be greatly missed by many of us.

His wife, Sally, made up for Tom's taciturnity and shyness with her cheerful friendliness, and she is also missed by all her friends. We wish them health and happiness in their retirement.

R.B.J.

The Retirement of Mr. A. Thompson, B.Sc. (Hons.).

In 1921, eleven members of the senior staff joined the Department of Agriculture, Federated Malay States, between May and December, and the last of them is now leaving us.

Mr. Aldworth Thompson, Senior Plant Pathologist, left Kuala Lumpur on leave prior to retirement on the 22nd September, 1951, his retirement to become effective on or about the 8th February, 1952. He is not, however, leaving Malaya altogether, for he is returning to Singapore in January, 1952, to take up an appointment as Senior Lecturer, Botany Department, University of Malaya.

Mr. Thompson graduated at University College, Cork, in 1920, and after a year's post-graduate study at the Royal College of Science, London, was appointed as Assistant Mycologist, Department of Agriculture, Federated Malay States, on the 22nd November, 1921. He arrived in Malaya on the 20th December, 1921, and was associated with Mr. Arnold Sharples on plant disease investigations.

He became Mycologist in 1933, on Mr. Sharple's transfer to the Rubber Research Institute, the title of this appointment, as head of the Plant Pathology Division, being changed on the 1st July, 1937, to Senior Plant Pathologist.

He was for long a member of the F.M.S. Volunteer Forces, and in 1940 he became associated, as Staff Sergeant, with the ambulance section of the F.M.S.V.F., being largely responsible for its effective organisation. As prisoner-of-war, he was 3½ years in Siam. After a long period of convalescence he returned to Malaya in February, 1947, and resumed duty as Senior Plant Pathologist.

He acted as Agricultural Economist and Editor of Departmental publications on two occasions before the war, and again during most of 1947, and as Chief Research Officer during 1948.

Phythophthora disease of Hevea rubber and other crops, and stem rot (*Fomes noxius*) of oil palms were perhaps his chief professional interests. After the war, with realisation of the dangers of disease introduction attendant on the greatly increased amount of air traffic and the appearance of new tropical plant diseases, Mr. Thompson took the initiative in proposals for a revision of the Malayan Plant Importation Rules, and the development of international phytosanitary co-operation. He was also responsible for the establishment of a plant inspection station at Pulau Tekong Besar, an island a few miles off Singapore.

He was responsible, too, for the technical arrangements with regard to the introduction, at the end of 1949, of a relatively large consignment of cacao seed from West Africa, personally collecting and accompanying the first consignment by air to Singapore, and the subsequent observations at Pulau Tekong before successful transfer to the Federation mainland.

"Tommy" has been a valuable member of the Research Staff of the Department of Agriculture, being a most competent plant pathologist; thoroughness, patience and persistence have always been associated with his work.

He was also very sociably inclined, played a fair game of tennis and golf, and was good at telling a story. Sometimes the stories were a little bit tall, and sometimes, perhaps, a little bit "beaverish", but he was always pleasant company and a good host.

Mr. and Mrs. Thompson will be missed from Departmental circles, and we wish them very well, whether in Singapore or at home.

R.B.J.

The Retirement of Che Jamaludin bin Aji.

Che Jamaludin bin Aji, Junior Agricultural Officer, Pahang South, left the Department on retirement in July, 1951, after nearly 35 years service.

Practically the whole of this service was spent in Pahang with the last 25 years in Temerloh, initially as Agricultural Assistant there and from 1936 onwards in charge of the Pahang South Circle. He and his contemporary, Che Jali bin Suleiman, who retired a year or so earlier, were unique in that, of all the Malay officers from other States who have served in Pahang, they really settled there and never worried about transfers back to their own State (Negri Sembilan). Possibly the fact that they married locally had something to do with this ! !

Che Jamaludin and the writer served together for five years and the latter is, therefore, in a position to testify from first-hand knowledge to the splendid service rendered by Che Jamaludin in Pahang. He had a bad time during the occupation and was never the same man afterwards. This was understandable in the circumstances and it is his work pre-war that we shall mainly remember.

Many of those who served in Pahang, in Departments other than his own, will remember Che Jamaludin for his sterling character, charm of manner and ability to mix with one and all. His colleagues in the Department and others who worked with him will join in wishing him a long and happy retirement.

R.G.H.

Appointments.

Mr. R. G. Heath, Chief Field Officer, has been appointed to act as Deputy Director of Agriculture, in addition to his own duties, with effect from the 10th September, 1951.

Mr. J. Chattaway, Agricultural Officer, has been appointed to act as State Agricultural Officer, Johore, with effect from the 22nd September, 1951.

The Right Honourable the Secretary of State for the Colonies has appointed Mr. J. L. B. Hitchcock to be an Agricultural Officer, Malayan Agricultural Service, with effect from the 13th October, 1951. Mr. Hitchcock assumed duty at the Federal Experiment Station, Serdang, on the 17th October, 1951.

Mr. R. B. Jagoe, Senior Botanist, has been appointed to act as Chief Research Officer, with effect from the 25th October, 1951.

Mr. L. N. H. Larter, Botanist, has been appointed to act as Senior Botanist with effect from the 25th October, 1951.

Mr. A. Johnston, Plant Pathologist, has been appointed to act as Senior Plant Pathologist, with effect from the 22nd September, 1951.

Mr. P. A. Gething, Agricultural Officer, has been transferred to the Malayan Agricultural Service from Nigeria. Mr. Gething arrived in Malaya on the 11th September, 1951, and has assumed duty in the post of State Agricultural Officer, Negri Sembilan.

Leave.

The following officers have proceeded on leave:—

Dr. A. E. S. McIntosh, Deputy Director of Agriculture, with effect from the 9th September, 1951.

Mr. R. Henderson, Agricultural Officer, with effect from the 22nd September, 1951.

Mr. A. Thompson, Senior Plant Pathologist, on leave prior to retirement, with effect from the 22nd September, 1951.

Dr. T. A. Buckley, Acting Chief Research Officer, on leave prior to retirement, with effect from the 24th October, 1951.

Mr. H. T. Pagden, Senior Entomologist, returned from leave on the 10th September, 1951, and has resumed duty at Headquarters.

Mr. H. F. Logan, Personal Assistant to the Chief Field Officer, returned from leave on the 11th September, 1951, and has been appointed to act as Personal Assistant to the Director of Agriculture.

MARKET PRICES

July to September, 1951.

Rubber.—The Singapore price of No. 1 R.S.S., f.o.b., in bales, buyer, continued to fluctuate from day to day during the third quarter of the year. During July the price ranged between 146½ and 137 cents per lb. The average price for the month was 142 cents per lb.

The price on the 1st August was 141 cents and, apart from a set-back in the middle of the month, the price gradually increased and was 147 cents on the 31st day. The average price for the month was 144.7 cents per lb.

The price had risen to 170 cents by the 10th September but three days later had decreased to 152 cents. There was a gradual rise to 160 cents on the 18th day but by the end of the month the price was back at 153½ cents per lb. The average price for September was 157.2 cents.

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the third quarter of 1951, are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, July to September, 1951.

(Dollars per picul of 133 1/3 lbs.)

Grades	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	July	Aug.	Sept.	July	Aug.	Sept.	July	Aug.	Sept.
Smoked Sheet	155.75	160.00	168.00	157.00	161.00	176.50	128.50	133.50	151.50
Unsmoked Sheet	131.50	132.50	145.00	127.00	133.00	146.00	121.25	128.75	140.31
Scrap	50.00	52.50	70.00	52.00	55.00	67.00	33.75	32.50	41.25

Transport from Batu Pahat to Singapore by lorry, excluding duty, $1.00 per picul.

Tea.—The average prices paid in Colombo for Malayan tea have not been quoted in the weekly reports of the Colombo Brokers' Association published during the third quarter of the year. In the report dated 26th June, 1951, the average price quoted was Rs. 1.86 per lb. The average prices of Ceylon teas, as quoted in the report dated 25th September, 1951, were as follows, in rupees per lb.: High Grown Teas 1.66, Medium Grown Teas 1.42, and Low Grown Teas 1.59.

The retail price of Malayan tea (Boh) is $2.60 per lb.

Derris.—The price of this commodity fluctuated during the quarter. The price on the 2nd July, as quoted in the weekly report of the Singapore Chamber of Commerce, was $115 per picul. On the 10th July the price was $110 and remained so for the rest of the month. On the 8th August it had risen to $125 and by the 13th day had risen to $140 per picul at which price the commodity remained until the 17th September. The nominal price quoted on the 24th September, 1951, was $125 per picul.

Tobacco.—The average prices paid per picul for cured leaf in Kelantan during the third quarter of 1951 were as follows:—1st quality $675, 2nd quality $350 and 3rd quality $138.

Rice.—The ration of rice continues to be 3½ katis per person per week. Rationed rice is sold in three grades, the range of prices of which are as follows, in cents per kati:—High Grade 32 to 36, Medium Grade 25 to 30, and Low Grade 19 to 21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1951								
2nd July -	37.50	71.00	990.00	1,000.00	85.00	18.25	26.50	20.00
9th July -	36.50	67.00	945.00	955.00	85.00	18.25	26.50	19.00
16th July -	36.00	65.00	945.00	955.00	85.00	18.00	26.50	18.00
23rd July -	36.00	66.00	920.00	930.00	83.00	18.50	26.50	18.00
30th July -	37.00	69.00	870.00	880.00	82.00	19.00	27.50†	19.00
7th Aug. -	38.50	72.00	875.00	885.00	80.00	18.50	27.50	19.00
13th Aug. -	37.50	71.00	905.00	915.00	80.00	18.50	27.50	19.00
20th Aug. -	38.50	71.00	950.00	960.00	80.00	18.50	27.50	19.00
27th Aug. -	39.50	70.00	910.00	925.00	80.00	19.00	27.50	18.00
3rd Sept. -	38.00	69.00	915.00	925.00	80.00	19.00	28.00	18.00
10th Sept. -	37.50	67.00	910.00	920.00	80.00	18.50	28.00	18.00
17th Sept. -	38.00	67.00	935.00	945.00	80.00	18.75	28.00	18.00
24th Sept. -	38.00	67.00	915.00	920.00	80.00	18.50	30.00	18.00

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1950	1951	1950	1951
January	3,959	4,068	896	1,178
February	3,643	3,510	970	970
March	4,861	3,821	1,184	1,196
April	4,918	3,732	1,249	1,083
May	4,433	4,260	1,086	1,258
June	4,226	3,295	1,070	968
July	4,361	3,249	1,070	901
August	4,586	3,913	1,193	1,061
September	4,085	4,614	1,095	1,257
October	4,859	4,854	1,234	1,338
November	4,697		1,168	
December	4,543		1,227	
Total	53,171	(39,316)	13,442	(11,210)

In October, 42 estates (planted area 91,711 acres) were in production out of a total of 52 oil palm estates (planted area 96,643 acres).

MALAYAN AGRICULTURAL EXPORTS, APRIL-JUNE, 1951.

Product	Net Exports in Tons.			
	Year 1949	Year 1950	Apr.-June, 1950	Apr.-June, 1951
Arecanuts	5,607	14,867	1,503	2,855
Coconuts, fresh †‡	21,971 †	36,917 †	12,758 †	4,167 †
Coconut oil ‡	60,504	56,045	12,381	15,987
Copra ‡	24,424 *	4,778	1,921 *	4,015
Copra cake	27,643 *	31,105 *	6,282 *	8,703 *
Gambier, all kinds	293	331	143	70
Palm Kernels	8,744	9,070	2,655	3,007
Palm Oil	55,211	50,638	12,232	9,444
Pineapples, canned	8,130	14,666	4,955	6,807
Rubber ¶	670,257 ¶	692,585 ¶	157,739 ¶	143,465 ¶
Sago,—flour	1,476	12,006	2,008	8,444
„ —pearl	3,477	1,665	275	856
„ —raw	1,317 *	15,693 *	3,331 *	6,585 *
Tapioca,—flake	737	1,098	343	251
„ —flour	278 *	2,782 *	1,120 *	870 *
„ —pearl	12,345	13,507	3,185	3,759
Derris	48	44	16	20
‡ Copra equivalent	74,334	96,589	18,453	30,077

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1950	1951	1950	1951	1950	1951
January	35,237	29,482	26,618	26,588	61,855	56,070
February	27,297	26,519	22,797	22,468	50,094	48,987
March	27,789	30,591	21,834	28,000	49,623	58,591
April	26,667	24,470	21,376	22,005	48,043	46,475
May	30,870	24,227	24,334	20,124	55,204	44,351
June	31,196	28,141	23,296	24,498	54,492	52,639
July	34,547	27,286	30,348	21,097	64,895	48,383
August	33,316	27,330	27,104	24,500	60,420	51,830
September	30,323	26,293	26,643	20,733	56,966	47,026
October	32,256	27,622	30,414	22,509	62,670	50,131
November	30,138		28,476		58,614	
December	36,217		33,492		69,709	
Total	375,853	(271,961)	316,732	(232,522)	692,585	(603,880)
Total 1949	400,009		270,248		670,257	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Smallholding production is estimated from purchases reported by dealers.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1950	1951	1950	1951	1950	1951	1950	1951	1950	1951
January	2,577	2,346	7,765	8,501	10,342	10,847	5,501	5,537	3,634	3,532
February	2,662	2,516	6,868	6,323	9,530	8,839	4,831	4,856	3,182	3,072
March	3,064	3,059	7,062	9,078	10,126	12,137	5,774	5,796	3,798	3,784
April	3,002	2,888	7,367	7,832	10,369	10,720	4,847	5,742	3,201	3,585
May	3,424	3,200	10,160	10,764	13,584	13,964	6,507	6,718	4,341	4,342
June	3,761	3,692	9,109	9,518	12,870	13,210	6,373	7,287	4,176	4,716
July	3,767	4,083	9,158	11,580	12,925	15,663	5,962	8,571	3,938	5,567
August	3,580	4,044	9,916	11,756	13,496	15,800	6,315	8,552	4,222	5,569
September	3,581	3,777	12,593	10,551	16,174	14,328	6,503	7,833	4,168	5,043
October	3,390	3,402	11,567	12,186	14,957	15,588	7,320	8,226	4,805	5,353
November	2,807		10,239		13,046		6,312		4,101	
December	2,997		9,062		12,059		6,555		4,253	
Total	38,612	(33,007)	110,866	(98,089)	149,478	(131,096)	72,800	(69,118)	47,819	(44,563)

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

FEDERATION OF MALAYA RICE STATISTICS.

Summary of Acreages and Production—Season 1950 - 1951.

State of Settlement (1)	Total Wet and Dry Padi									
	Area Planted (2)		Area Destroyed (3)		Area Harvested (4)		Yield of Padi (5)		Rice Production (6)	
	acres	per cent. of total	acres	per cent. of (2)	acres	per cent. of (2)	gantangs (000's)	per cent. of total	tons	per cent. of total
Perlis - -	48,050	5.5	—	—	48,050	100.0	18,937	6.8	29,820	6.8
Kedah - -	285,220	32.9	110	—	285,110	100.0	118,676	42.6	186,890	42.6
Kelantan - -	165,890	19.2	690	.4	165,200	99.6	43,117	15.4	67,910	15.4
Trengganu - -	57,820	6.7	—	—	57,820	100.0	13,858	5.0	21,830	5.0
Penang & P. Wellesley	39,800	4.6	40	.1	39,760	99.9	10,666	3.8	16,790	3.8
Perak - -	105,250	12.1	2,900	2.8	102,350	97.2	29,219	10.5	46,010	10.5
Selangor - -	50,060	5.8	280	.6	49,780	99.4	15,600	5.6	24,570	5.6
Pahang - -	41,530	4.8	590	1.4	40,940	98.6	10,230	3.7	16,110	3.7
Negri Sembilan -	31,600	3.6	490	1.6	31,110	98.4	9,306	3.3	14,660	3.3
Malacca - -	32,020	3.7	3,380	10.5	28,640	89.5	8,006	2.9	12,600	2.9
Johore - -	9,640	1.1	2,200	22.8	7,440	77.2	1,140	.4	1,790	.4
Total -	866,880	—	10,680	1.2	856,200	98.8	278,755	—	438,980	—
Off-Season Crop -	8,510	—	90	1.1	8,420	98.9	2,414	—	3,800	—
Total 1950 - 51 -	875,390	—	10,770	1.2	864,620	98.8	281,169	—	442,780	—
Total 1949 - 50 -	930,530	—	20,200	2.2	910,330	97.8	276,764	—	435,840	—

Acreage to nearest 10 acres.
Rice production to nearest 10 tons.
Conversion Rate: 635 gantangs padi = 1 ton rice (i.e. milling recovery = 63 per cent.).

FEDERATION OF MALAYA RICE STATISTICS.

Off-Season Crop 1950.

State or Settlement (1)	WET PADI				DRY PADI				TOTAL PADI AND RICE			
	Area Planted (acres) (2)	Area Harvested (acres) (3)	Yield of Padi (gantangs) (4)	Average Yield per acre (gantangs) (5)	Area Planted (acres) (6)	Area Harvested (acres) (7)	Yield of Padi (gantangs) (8)	Average Yield per acre (gantangs) (9)	Area Planted (acres) (10)	Area Harvested (acres) (11)	Total Yield of Padi (gantangs) (12)	Rice Production (tons) (13)
Perlis - -	—	—	—	—	—	—	—	—	—	—	—	—
Kedah - -	536	536	236,800	442	—	—	—	—	536	536	236,800	370
Kelantan - -	370	370	108,800	294	—	—	—	—	370	370	108,800	170
Trengganu - -	—	—	—	—	—	—	—	—	—	—	—	—
Penang & P. Wellesley	6,408	6,392	1,878,000	294	—	—	—	—	6,408	6,392	1,878,000	2,960
Perak - -	—	—	—	—	—	—	—	—	—	—	—	—
Selangor - -	—	—	—	—	—	—	—	—	—	—	—	—
Pahang - -	775	700	117,000	167	407	407	69,000	170	1,182	1,107	186,000	290
Negri Sembilan -	—	—	—	—	—	—	—	—	—	—	—	—
Malacca - -	11	11	4,100	373	—	—	—	—	11	11	4,100	10
Johore - -	—	—	—	—	—	—	—	—	—	—	—	—
Total 1950 -	8,100	8,009	2,344,700	293	407	407	69,000	170	8,507	8,416	2,413,700	3,800
Total 1949 -	9,160	8,740	1,920,000	220	480	460	46,000	100	9,640	9,200	1,966,000	3,090

Rice production to nearest 10 tons.

CONVERSION RATE: 635 gantangs padi = 1 ton rice (i.e. milling recovery = 63 per cent.).

METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning cbs.	Gale force 8 or more			
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	92.0	72.2	82.1	95	67	84	76			6.65	168.9	2.04	12	10	4			200.75	6.47	
Port Swettenham, Selangor	89.4	72.2	80.8	94	68	83	75	85.0	85.7	8.87	225.3	2.18	15	12	4			214.52	6.92	
Kuala Lumpur, Selangor	89.9	72.9	81.4	93	69	85	76			8.70	221.0	2.09	12	11	8	2				
Sitiawan, Perak	90.0	72.4	81.2	92	70	82	75	85.3	86.0	6.74	171.2	2.30	12	19	1	1		216.90	7.00	
Kuala Lipis, Pahang	90.4	70.7	80.1	93	68	88	74	84.6	85.1	6.04	153.4	0.88	17	17		25		198.30	6.40	
Kuantan, Pahang	90.7	72.3	81.5	93	69	86	76			12.21	310.1	2.83	15	14	4	5		199.90	6.45	
Temerloh, Pahang	91.5	71.4	81.5	94	69	88	74			4.35	110.5	1.40	15	14	1	1		203.60	6.57	
Bayan Lepas, Penang	87.7	74.6	81.1	90	72	84	78			9.87	250.7	1.85	15	13	1			203.92	6.58	
Malacca	86.1	73.7	79.9	88	71	83	76			11.21	284.7	2.90	18	17	8		5	189.70	6.12	
Mersing, Johore	88.1	72.5	80.3	92	69	82	76			6.83	173.5	2.72	13	11	6		1	210.55	6.79	
Alor Star, Kedah	88.5	73.9	81.2	91	71	84	76			9.69	246.1	2.66	18	15	2		1	203.87	6.58	
Kota Bharu, Kelantan	89.8	74.0	81.9	93	72	87	76	87.1		4.58	116.3	2.18	11	8	10			244.70	7.89	
K. Trengganu, Trengganu	89.4	72.6	81.0	92	70	84	75			5.04	128.0	3.32	9	8	7	1	2	234.60	7.57	
Kallang Aerodrome (S'pore)	86.8	76.3	81.5	91	72	82	81			4.77	121.2	0.94	15	15	4			173.30	5.59	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	75.5	61.7	68.6	77	60	72	64	72.6	72.9	4.99	126.7	1.65	14	13	2	6		206.00	6.65	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	73.6	55.6	64.6	77	52	67	60	68.2	69.5	9.94	252.5	2.57	14	13	2	1		160.95	5.19	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more.	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	90.7	72.4	81.5	95	70	87	75			9.66	245.4	1.52	22	20	2	1		167.10	5.57	
Port Swettenham, Selangor	88.6	72.2	80.4	91	70	83	74	84.3	85.6	11.79	299.5	3.44	17	16	3			180.96	6.03	
Kuala Lumpur, Selangor	89.7	72.9	81.3	93	70	85	75			14.17	359.9	4.12	18	18	10	9				
Sitiawan, Perak	88.9	72.8	80.9	92	71	84	75	85.3	86.1	5.92	150.4	1.13	18	16	1			184.10	6.14	
Kuala Lipis, Pahang	89.4	71.5	80.5	91	70	82	73	84.3	84.9	10.99	279.1	1.90	21	21		29		179.30	5.98	
Kuantan, Pahang	89.4	72.1	80.7	92	69	83	74			11.82	300.2	2.83	20	18	5	5		174.30	5.81	
Temerloh, Pahang																				
Bayan Lepas, Penang	86.7	74.9	80.8	89	73	80	78			12.03	305.6	2.51	23	20	1			171.80	5.73	
Malacca	85.8	74.0	79.9	88	72	83	77			12.60	320.0	2.45	20	18	3		3	211.80	7.06	
Mersing, Johore	87.7	72.1	79.9	91	68	84	75			7.86	199.6	2.00	16	14	2			224.70	7.49	
Alor Star, Kedah	86.9	73.6	80.3	90	72	81	75			13.63	346.2	2.79	21	18				171.76	5.73	
Kota Bharu, Kelantan	88.7	73.9	81.3	91	70	85	77	86.3		7.75	196.9	2.90	18	7	7			199.05	6.63	
K. Trengganu, Trengganu	88.2	72.6	80.4	92	71	82	75			8.63	219.2	2.97	19	17	4		1	209.25	6.97	
Kallang Aerodrome (S'pore)	86.9	75.6	81.3	90	71	82	81			5.66	143.8	1.77	14	12	2			204.35	6.81	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.6	61.8	68.2	77	60	71	64	72.4	72.8	11.26	286.0	1.77	20	18		10		152.14	5.07	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.7	57.0	64.9	78	53	68	62	68.7	69.7	20.47	519.9	2.73	27	27		1		113.55	3.79	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1951

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										ins.	m.m.	ins.						hr.	hr.	
Ipoh, Perak	90.6	72.3	81.5	95	70	85	75			7.54	191.5	1.62	20	18	2	2		173.05	5.58	
Port Swettenham, Selangor	88.1	72.4	80.3	91	70	84	75	83.5	85.1	12.97	329.4	3.33	20	18	4	2		144.78	4.67	
Kuala Lumpur, Selangor	88.9	73.0	80.9	92	71	84	75			8.24	209.3	1.52	22	21	4	4				
Sitiawan, Perak	88.9	72.5	80.7	91	71	82	74	84.8	85.8	7.81	198.4	1.86	14	12		3		175.27	5.65	
Kuala Lipis, Pahang	89.5	71.7	80.6	92	70	85	74	84.2	84.8	6.89	175.0	2.28	20	20	3	29		166.80	5.38	
Kuantan, Pahang	89.2	72.5	80.9	93	70	83	77			7.97	202.4	1.64	23	19	2	6		160.55	5.18	
Temerloh, Pahang																				
Bayan Lepas, Penang	87.1	74.3	80.7	89	73	83	76			11.29	286.8	2.08	24	19	2			191.77	6.19	
Malacca	85.3	73.3	79.3	88	71	79	75			11.39	289.3	2.20	17	14	2		1	184.29	5.94	
Mersing, Johore	87.4	72.1	79.7	91	70	82	74			6.59	167.4	1.10	18	14	5			195.70	6.31	
Alor Star, Kedah	87.3	73.3	80.3	91	71	81	75			7.85	199.4	2.30	21	18	2			192.97	6.22	
Kota Bharu, Kelantan	87.5	74.2	80.9	92	72	82	76			7.70	195.6	1.21	18	16	8	1		201.90	6.51	
K. Trengganu, Trengganu	87.4	73.2	80.3	91	71	81	75			8.50	215.9	1.16	20	20	2			184.15	5.94	
Kallang Aerodrome (S'pore)	86.8	74.8	80.8	91	73	83	78			2.17	55.1	0.58	14	10	6			171.20	5.52	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.																				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.5	57.0	64.7	76	53	68	62	68.6	69.6	11.51	292.4	2.43	25	25				128.60	4.15	

Compiled from Returns supplied by the Malayan Meteorological Service.